ELECTRA

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AJAY BINAY INSTITUTE OF TECHNOLOGY
DEPARTMENT OF ELECTRICAL ENGINEERING
DEPARTMENT OF EEE

ELECTRA

The Quarterly E-Magazine of Electrical and EEE Department

2018-2019(Vol.-1, Issue-I)

AJAY BINAY INSTITUTE OF TECHNOLOGY

PLOT NO.-11/1/A, SECTOR-1, CDA, CUTTACK-753014

Website: - www.abit.edu.in

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2018-2019(Vol.-1, Issue-I)

MESSAGES

FROM THE DIRECTOR'S DESK

The Electrical Engineering department has planned to publish "ELECTRA" in the New Year. I am confident that this new initiative in the New Year will bring in focus & build knowledge in the department and institute.

I congratulate the entire department on this novel attempt & wish them all a very Happy New Year.

Ar. K.B.Mohapatra

Director, ABIT Group of Institutions

FROM THE HEAD GOVERNING BOARD'S DESK

Information compilation and sharing through various channels is an inherent mechanism of knowledge building in a team. I am very happy that the Electrical Engineering department has taken the initiative of publishing "ELECTRA", which is a major step towards this philosophy. I am grateful to the leaders who have planned this and hope that the faculty members as well as students will take away necessary learning from this publication.

Er. Satyadarshi Mishra

Head of Governing Board

ABIT, Cuttack

FROM THE DIRECTOR (P&NI)'S DESK

I am happy to know that the Electrical Engineering department is publishing "ELECTRA". I am sure that such effort will trigger a flurry of activities leading to higher motivation and energy levels. This will certainly enhance the competence of the department. I thank the H.O.D and faculty members for taking up this initiative.

Er.(Mrs.) Payal Mahapatro

Director (P&NI)
ABIT, Cuttack

FROM THE PRINCIPAL'S DESK

I am happy to learn that the department of EE and EEE is bringing out its E-Magazine. Also glad to pen few words exclusively meant for churning out latent writing skills on the different recent technical field of research. ABIT has come a long way & has made its impact felt in not only in state but also in country and abroad. Our students and faculties have performed exceedingly well and competent enough in all the fields. Beyond academics, the research activities are being conducted. The college also motivates and encourages staff and students to undertake research and enterprising skills. The faculty members plays major role in the overall development of department and institute.

I congratulate the department, the contributors and editorial boards for bringing out such technical publication. I extend my greetings and best wishes to the faculties and students of the department and wish their endeavors my very best.

Dr. Leena Samantray

Principal, ABIT, Cuttack

FROM THE DEAN (ACADEMIC)'S DESK

I am glad to know that the Electrical Engineering Department of ABIT is bringing out a technical magazine with a flying color which will install creativity in the minds of the students as well as the staff members.

I congratulate the faculty, staff and students of EE and EEE department for their sincere efforts to publish this magazine and I wish the magazine all success.

Dr. P.K.Pany

Dean, Academics

FROM THE DEAN (OPERATION)'S DESK

I extend my heartiest congratulation to the dynamic Team of the Department of Electrical Engineering and Department of Electrical & Electronics Engineering for their initiative to release the first issue of "ELECTRA" the e-Magazine.

As Abdul Kalam Says: ***If You FAIL, never give up because F.A.I. L. means "First Attempt in Learning". END is not the end; in fact E.N.D. means "Effort Never Dies". If you get NO as an answer, remember N.O means "Next Opportunity"***

I hope the attempt made will lead this magazine to National Repute.

Dr. Bichitrananda Guru

Dean Operations

FROM THE DEAN (RESEARCH)'S DESK

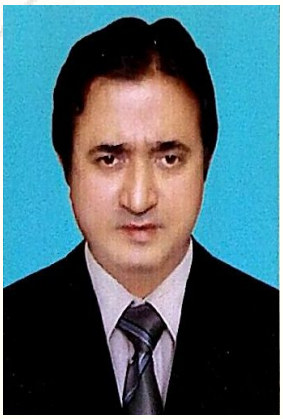
Dear Readers

A weak link is better than a strong memory. It can make a reader travel down the lanes of memory, giving rise to a surge of emotions of many hues and colors.

I am happy to see the amount of enthusiasm of eminent members of the college to contribute to the magazine. This shows the positive and creative energy of faculty members and students present in the college. We intend to continue presenting the talent and creativity of our staff and students through this magazine

Dr. Gayatri Devi
Dean Research

FROM THE HEAD OF DEPARTMENT DESK



I am very much happy that our both the department have taken steps to publish the quarterly e-magazine "ELECTRA". I hope it will create enthuse among students and staffs in future.

Prof. A.K.Mahapatra

Head of Department

EE & EEE

Editorial Message

It is an occasion of immense pleasure for the Department of Electrical and Electrical & Electronics Engineering to publish the first volume of E-magazine "ELECTRA" from the year 2019.

The Editorial board of department of EE and EEE wants to thanks all the faculty members and students who have made this issue a success by providing an article for the first volume.

This magazine focuses on the recent trends evolved in the field of electrical engineering & wants to provide advanced knowledge and awareness among the students about the same.

The Editorial board also wants to thanks the Management of the Institute and Head of the department for inspiring us to go forward in publishing this magazine and we hope that this kind of support will be provided from all of the involved persons, for the next issue in 2019.

Editorial Board

Er. Chandan Mandal (Editor & Author)

Er. Shakti Prasad Mohanty (Editor & Author)

Er. Satya Ranjan Das (Editor & Author)

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Reliability & Deregulation

Prof. (Dr.) Prasanta Kumar.Pany
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The natural monopoly of the transmission and distribution network operators has created a well-founded concern that the reliability of the power supply will decrease in future. To prevent this, a certain amount of regulation is unavoidable. A regulatory body needs to collect and publish performance indicators of all transmission and distribution companies. The regulatory body also needs to set standards for the reliability performance, including a penalty system. Possible options are the payment of compensation to customers and a control of the distribution and transmission charges depending on the reliability performance. The techniques for the data collection and the calculation of performance indicators are well developed and can directly be used.

The risk of a serious blackout requires a somewhat different approach. The consequences of such an event are so large that it is not appropriate to wait for the collection of sufficiently confident statistics. Some kind of stochastic prediction of the risk of a blackout needs to be applied to the system. When this risk becomes unacceptably high, the regulatory body should intervene. In many deregulated markets, this task lays with the operator of the transmission grid. Unfortunately, implementation of the task is not very transparent. The main problems are expected at transmission level.

Various markets mechanisms may also be used to prevent too much reduction in supply reliability, especially to prevent shortages in generation capacity and in transport capacity in the transmission network.

New reliability analysis tools need to be developed to include the uncertainties of the market in reliability planning tools, and to enable the application of reliability techniques at the system operational level.

Modelling of PV Cells & its Impact on Grid

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Generation of solar energy has tremendous scope in India. The geographical location of the country stands to its benefit for generating solar energy. The reason being India is a tropical country & it receives solar radiation almost throughout the year, which amounts to 3000 hours of sunshine. This is equal to more than 5,000 trillion KWh. Almost, all parts of India receive 4-7 kwh of solar radiation per sq meters .This is equivalent to 2300 -3200 sunshine hours per year.

Electricity demand,, a rising interest in clean technologies ,saturation of oil resources and energy security are reasons for demand for renewable energy generation systems which is rising every year.

Among all the renewable energy sources the use of solar energy is increasing rapidly due to its availability & advancement in Photovoltaic technology.

But integration of PV technology to utility grid is a critical process. In this present scenario current controlled pulse width modulated voltage source inverter is widely used.

SOLAR PV MODULE:- Photovoltaic modules are composed of many PV cells connected in series (usually 36 no's) (Ethyl vinyl acetate) An insulating tidlar sheet is placed beneath PV modules are thin silicon wafers sealed between a layer of toughed glass & layers of EVA (Ethyl Vinyl Acetate).An insulating tidlar sheet is placed beneath layers for further protection.PV systems are generally classified as grid connected and stand- alone systems. Fig 1 and fig.2

Grid- connected PV systems operate in parallel with & interconnected with the electric utility Grid. The primary component is inverter PCU(Power conditioning unit).PCU which converts DC power by PV array in to AC power in consistency with voltage & power quality requirement of utility Grid .A bi-directional interface is made between PV system AC O/P circuits & electric Utility network.

Stand-Alone PV systems operate independently and are designed to supply certain DC or AC electrical loads. These systems are powered by PV array only.

The V-I characteristics of a PV module as shown in fig. 1 is a non-linear graph between current and voltage generated by a PV module (Maximum Power Points) are shown to represent the point at which power drawn from a PV module is maximum . MPL represent the track or path tracked by maximum power point tracking (MPPT).

The P-V Characteristics of a PV module as shown in fig .2 is a non linear graph plotted between power & voltage of a PV module, for different densities W/m^2,different graphs are plotted.

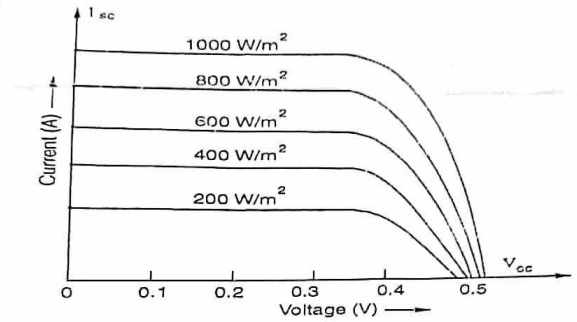

Figure 1- V-I characteristics of a PV Module

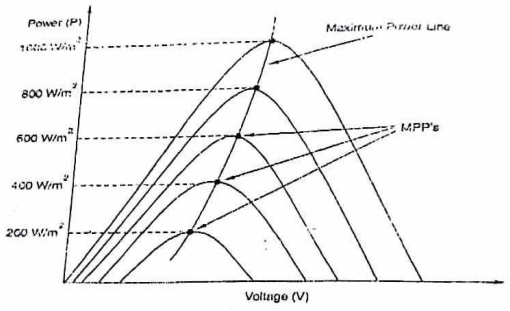

Figure 2- P-V Characteristics of a PV Module

Designing PV cells with some electrical appliances like DC-DC boosters are very useful in boosting up the voltage where ever it is necessary & also for suppressing the ripples, etc. DC-DC choppers with variable duty cycle can be used along with filters.

Energy Storage System

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Introduction

Electrical power infrastructures are changing dramatically around the globe due to smart grid initiatives, the establishment of renewable and the resulting distributed nature of creating electricity, the need for independent micro grids to ensure grid reliability, new demands from end users, the need to reduce greenhouse gas emissions, as well as the capability to accommodate mixed energy resources. As a result, the power network faces great challenges in generation, transmission and distribution to meet new and many times unpredictable demands of providing coherent electricity supply. Electrical Energy Storage (**EES**) has been considered a game-changer with a number of technologies that have great potential in meeting these challenges. The suitability of a storage technology is determined primarily by its power and energy capacity and the rate at which these can be stored and delivered. Other characteristics to consider are round-trip efficiency, cycle life, calendar life, safety, reliability, effect on the environment and ramp rate (how fast the technology can respond to a command). Other energy storage technologies such as compressed air fly wheel, and pump storage do exist, but recent generation focuses on battery energy storage systems (**BESS**) and its related applications.

Overview of the Energy Storage Technologies

Today, most common battery chemistries are based on lead, nickel, sodium and lithium electro chemistries. Emerging technologies like flow batteries utilize various transition metals like vanadium, chromium and iron as the electro active element. Carbon electrodes are a critical part of several of these battery systems. . Each storage type has distinct characteristics, namely, capacity, energy and power output, charging/discharging rates, efficiency, life-cycle and cost that need to be taken into consideration for possible applications. Understanding their chemical characteristics and related regulations are critical steps for possible use. This includes the application, sitting, installation, operation and maintenance, as well as shipping and disposing of used batteries. This topic presents a survey of available and emerging battery technologies and their design and performance characteristics. Electric Double Layer Capacitors (often referred to as ultra capacitors or super capacitors) are also addressed in this topic.

Lead acid batteries:

The lead-acid battery was invented in 1859 by French physicist Gaston Planet and it is the oldest and most mature rechargeable battery technology. There are several types of lead-acid batteries that share the same fundamental configuration. The battery consists of a lead (Pb) cathode, a lead-dioxide (PbO_2) anode and sulphuric acid electrolyte (H_2SO_4). The deep cycle/traction and the traditional stationary battery types are the most commonly used in Smart Grid applications. The deep cycle battery is composed of very thin plates and has a low energy density; however,

its relatively high power density makes it attractive for use in motor vehicles to provide the high current required for power engine starters.

The larger format and thicker plate stationary battery is used in a number of applications where interruption to the load cannot be tolerated. Common use in the energy space includes standby backup power for switchgear, turbine motors, data centres and any other application where reliability of the load is critical. Lead-acid batteries are widely used because they are less expensive compared to many of the newer technologies and have a proven track record for reliability and performance.

Nickel–Cadmium batteries

The nickel–cadmium battery (NiCd) is a rechargeable battery using nickel oxide hydroxide and metallic cadmium as electrodes. Wet-cell nickel-cadmium batteries were invented in 1899. A NiCd cell delivers around 1.2 volts output voltage until nearly the end of discharge. Compared with other types of rechargeable batteries, NiCd batteries offer satisfactory life-cycle characteristics and improved performance at low temperatures with a good capacity retention at high rates. However, the material costs are higher than that of the lead acid batteries. Moreover, NiCd cells experience the so called “memory effect” and high self-discharge rates which have a great impact to their performance characteristics. In addition, an environmental concern on the disposal of the toxic metal cadmium has dramatically reduced the use of NiCd batteries.

Nickel–metal hydride batteries

A nickel–metal hydride battery (NiMH) is also a type of rechargeable battery. Similarly to NiCd batteries, NiMH cells use nickel oxide hydroxide (NiOOH), which is formed in the positive electrode. The use of Cd in the negative electrode is replaced by a hydrogen-absorbing alloy. A NiMH battery can have two to three times the capacity of an equivalent size NiCd, and its specific energy of 80Wh/kg is about 50% of a lithium-ion battery. Main applications of the NiMH batteries are found in consumer electronics and plug-in electric vehicles and hybrid vehicles due to the technology maturity and their competitive cost to Li-ion batteries. However, Li-ion batteries are considered to most promising for the EV industry mainly due to their continuously falling cost and improved performance.

Lithium-ion batteries

In 1991, Sony and Asahi Kasei released the first commercial lithium-ion battery. A lithium ion battery (Li-ion) is a type of rechargeable battery where lithium ions move from the negative electrode to the positive electrode during discharge. The process is reversed during charging. With a high energy density, negligible memory effect and low self-discharge, Li-ion batteries are one of the most popular types of rechargeable batteries for portable electronics. In recent years, they are also growing in popularity for military, Plug-in electric vehicle (PEV), and aerospace applications. Different types of Li-ion battery chemistries present different performance, cost and safety features that can suit a variety of applications. For example, lithium cobalt oxide ($LiCoO_2$) batteries are used in most handheld electronics due to their high energy density and low weight. Other types such as Lithium iron phosphate ($LiFePO_4$), lithium ion manganese oxide batteries ($LiMn_2O_4$, Li_2MnO_3, or LMO) and lithium nickel manganese cobalt oxide ($LiNiMnCoO_2$ or NMC) offer lower energy density, but can provide longer lifetime and inherent safety. These types are widely used for electric tools and medical equipment. The newer

emerging type of lithium–sulphur batteries promises the highest performance-to-weight ratio. Li-ion batteries present a high efficiency and a long lifespan. The technology is still under development, therefore further performance improvements may be expected in the future. In January 2017, Tesla Motors began production of lithium-ion battery cells for energy storage at its Giga factory in Nevada. The high-performance cylindrical "2170" cell, jointly designed by Tesla and its Japanese partner Panasonic, will be used in Tesla's Power pack 2 and Power wall 2. In 2018, it is expected to be used for its Model 3 electric vehicles as well.

Flow batteries

Flow batteries are considered unique in that the power and energy of the battery are entirely decoupled. A flow battery is consists of multiple electrochemical cells connected in series in a stack. These stacks are then connected in series and/or stacks to form a Flow Battery Energy Storage System (FBESS). The stack configuration dictates the power of the cell while the energy is controlled by the chemical energy contained in the electrolyte tanks that are external to the stack. Positive and negative electrolyte solutions are pumped into the stack where they are separated by ion-exchange membranes or a porous separator. Ion exchange (accompanied by flow of electric current) occurs through the membrane while both liquids circulate in their own respective space. There are several types of flow batteries such as Fe-Cr, Fe-V (vanadium 10 redox) and hybrid flow systems such as Zinc-Bromide (Zn-Br2) and Zinc-Chloride (Zn-C12). These are typically aqueous based solutions, and thus cell voltages are limited between 1.0 to 1.8 volts to prevent hydrolysis of the water. Non-aqueous electrolyte flow battery systems have the potential for higher energy density due to high open circuit voltage and a potential for more than 1 electron per mole of the active species. However, these are still under development. Currently, the most cost effective flow battery that exhibits good performance and safety is the all vanadium redox flow battery. Since the power and energy of the flow battery are separate, specialized cost performance models are required to determine the optimal energy to power stations for grid storage applications. Flow batteries are analogous to a fuel cell to the extent that reactants flow past or through the electrodes. The conversion is less than 100% per pass. Flow batteries have several technical advantages over conventional rechargeable batteries, but a monitoring and control mechanisms is required. Flow batteries are inherently safe as the aqueous electrolyte is non-flammable. Flow batteries are most cost effective for longer duration, energy intensive applications. However, they do retain their ability to do fast ramp rates. This enables them to provide multiple power and energy services. This operational flexibility makes the flow battery very attractive for grid scale applications.

Sodium–sulphur batteries

A sodium–sulphur (NaS) battery is a molten-salt battery constructed from liquid sodium (Na) and sulphur (S). NaS batteries are fabricated from inexpensive materials, which form one of the main advantages of this technology type. NaS batteries have high energy density, high efficiency of charging/discharging (89–92%) and long cycle life. The main drawbacks of the NaS battery are the operating temperatures of 300^0C to 350^0C and the highly corrosive nature of the sodium polysulphides. Battery cells become more economical with increasing size, therefore NaS batteries are considered more suitable for stationary energy storage applications. Typical applications of NaS batteries are distribution network support and grid services and renewable

energy integration. The technology has a great potential for grid services since it has a long discharge time and can respond precisely to improve power quality issues in the grid.

Sodium-nickel-chloride batteries

Sodium-nickel-chloride (NaNiCl2) is high-temperature batteries similarly to NaS batteries. Their operating temperature lies within the 270^0 C-350^0 C range. During the charging process, salt (NaCl) and nickel (Ni) are transformed into nickel-chloride (NiCl2) and molten sodium (Na). The process is reversed during discharge. Typical applications of NaNiCl2 batteries are grid support services and renewable energy integration.

Electric Double layer Capacitors

Electric Double Layer Capacitors (EDLCs), also known as "ultra capacitors" or "super capacitors" store electrical charge in an electric double layer (non-Faradic) at the interface between a high-surface-area carbon electrode and a liquid electrolyte. This mechanism is highly reversible and therefore just as with ECs, conventional capacitors, can be charged and discharged at high power rates with low capacitance fades for hundreds of thousands of cycles. The electrode surface area in capacitors determines the capacitance and thus, the energy storage capability of the device. The amount of energy stored by EDLCs is very large compared to conventional capacitors because of the use of a porous carbon-based electrode material of high surface area. While ultra capacitors have very high specific power (10-20 kW/kg), and longer lifetime relative to batteries, they have a low specific and volumetric energy density (<8Wh/kg).

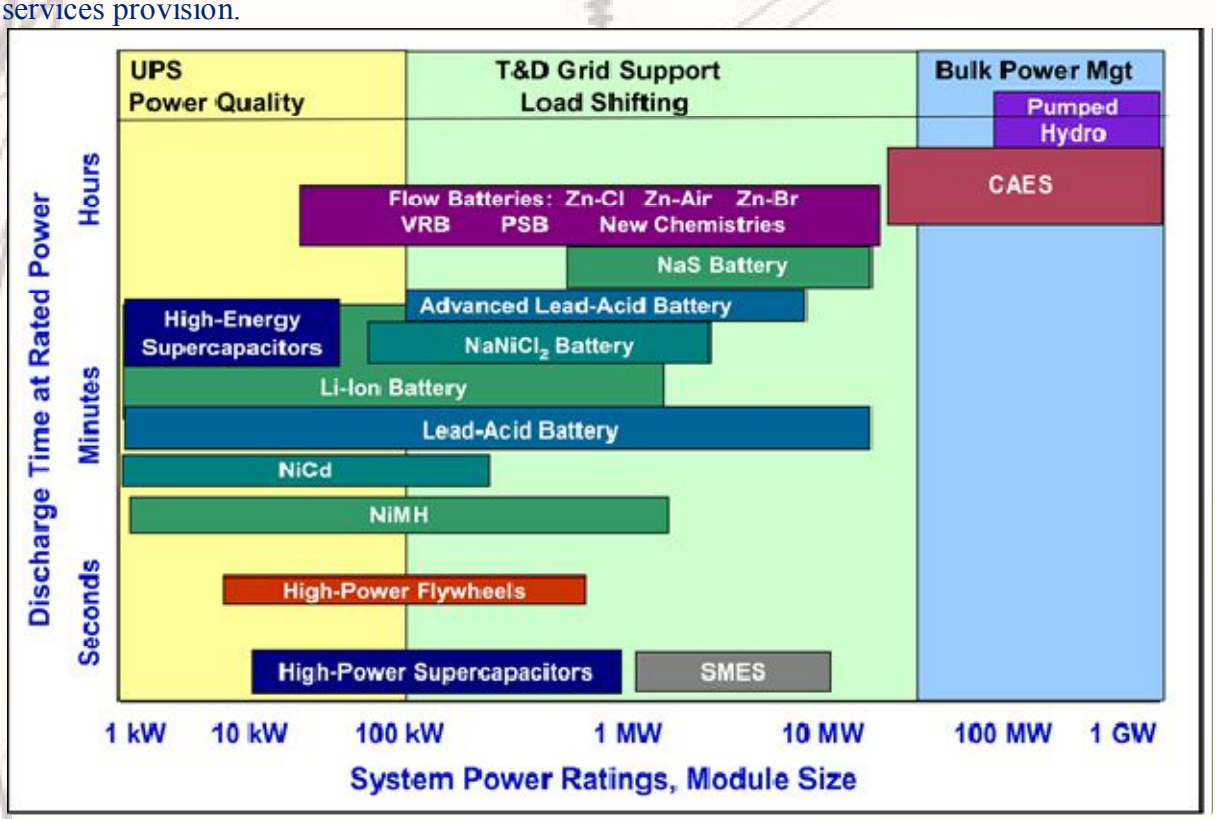
Ultra capacitors exhibit significantly less sensitivity to temperature than Li-ion batteries. Ultra capacitors are well-suited for high power applications in a variety of areas, with applicability at Transmission, sub-transmission, as well as distribution voltage levels. The key features of ultra capacitors are extremely appealing in electricity grids: fast response time in milliseconds, high-energy efficiency (> 95%), high power density and long calendar and cycle life. Deployment of EDLCs has accelerated greatly over the last 15 years; they are now widely commercialized in hybrid bus, rail, and automotive applications, as well as back-up power applications such as wind pitch control systems and uninterrupted power supplies. Moreover, there are several trials and pilot projects that study the utilization of super capacitors for grid energy storage systems. They can be a stand-alone technology or hybridized with a second, low cost high energy density technology such as flow batteries or high energy Li-ion batteries.

Comparison of battery storage technologies

A summary of the energy storage technologies discussed above is presented at table. Different types are compared by their main technical characteristics, such as cycle life performance and efficiency.

Storage technology	Cycle life at 80% DOD	Efficiency	Advantage	Disadvantage
Lead Acid	300-3000	70-90%	- Inexpensive -Mature technology	- Limited cycling capability for most standard types - Low energy density - Environmental hazard
NiCd	3000	80%	-Good cycle life -Good performance at low temperatures -More tolerant to hostile environments or conditions.	- Memory effect - High self-discharge rate - Environmental hazard
NiMH	2000	50-80%	- High energy density -Good abuse tolerance -Good performance at low temperatures	-Damage may occur with complete discharge - High costs
Li-ion	3000	75-90 %	-High energy density -Low self-discharge rate - No memory effect	- Expensive although costs are decreasing - Not safe depending on type
Flow batteries	2,000-20,000	65-85 %	- Scalability -Lifespan not dependent on DOD	- Need for electrolyte tanks - High maintenance -Complex monitoring and control mechanisms .
NaS	4500	89 %	- High efficiency and cycle life - Low cost battery materials - High energy density	- High operating temperatures -Temperature is to be maintained close to 300C which might affect battery performance - Corrosive materials
NaNiCl2	1,500-3,000	85-95 %	- Long cycle life - High energy density	- High operating temperatures - Thermal management requirement

In addition a conceptual classification of energy storage devices is shown in Fig. 2 in terms of their power and energy relationship and potential use-cases and applications focusing to grid services provision.



Energy storage technologies and their main applications

Conclusion

Companies deploy storage technologies for a number of different purposes. Coordinating and rearranging energy from diverse resources to optimize the overall production/operation cost is only one of the many applications of energy storage. Energy storage can also improve the quality of power through frequency regulation and provide an uninterruptible source of power for critical infrastructure and services. Energy storage using grid-connected electrochemical battery systems has widely been considered as a potential solution for seamless integration of renewable, improving grid flexibility, and enhancing grid reliability.

Flexible AC Transmission System Controllers

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The electricity supply industry is undergoing a profound transformation worldwide. Market forces, scarcer natural resources, and an ever-increasing demand for electricity are some of the drivers responsible for such unprecedented change. Against this background of rapid evolution, the expansion programs of many utilities are being thwarted by a variety of well-founded, environment, land-use, and regulatory pressures that prevent the licensing and building of new transmission lines and electricity generating plants.

The ability of the transmission system to transmit power becomes impaired by one or more of the following steady state and dynamic limitations:

- Angular stability,
- Voltage magnitude,
- Thermal limits,
- Transient stability,
- Dynamic stability.

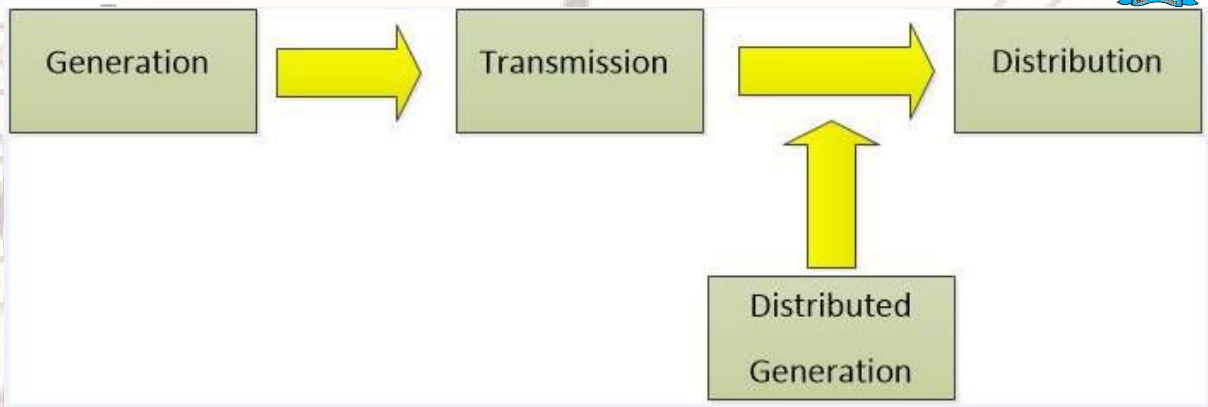
These limits define the maximum electrical power to be transmitted without causing damage to transmission lines and electrical equipment.

POWER SYSTEM CONTROL:

Generation, Transmission, Distribution

Power system consisting of generation, transmission, distribution and consumption of electrical energy can be detached into zones as shown in Figure:

1. Generation
2. Transmission
3. Distribution
4. Distributed Generation



(Block diagram of Generation, Transmission & Distribution)

Power System Constraints

There are many power system constraints and they put a limit over power transfer among areas. The typical constraints are:

1. Thermal
2. Dynamic Voltage and voltage stability
3. Power System Oscillation Damping
4. Short Circuit Current and Other limitations

Some of the above constraints also influence the transmission system; hence there is a requirement for a solution to use with the transmission lines with highest possible efficiency.

Power system controllability

To improve the performance of a power system there are three key variables that must be controlled. The three main variables are: Voltage, angle and impedance

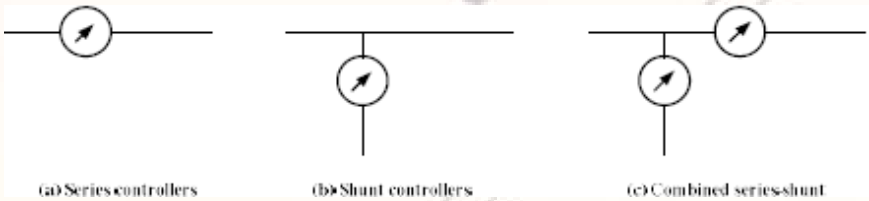
AC network controllers used to improve the performance of a power system can be classified in two categories, conventional network controller and FACTS controller

FACTS Controllers

Flexible AC Transmission System (FACTS) is defined by as "Alternating current transmission systems incorporating power electronic-based and other static Controllers to enhance controllability and increase power transfer capability."

The significance of the power electronics and other static Controllers is that they have high-speed response and there is no limit to the number of operations. Like a transistor leads to a wide variety of processors, power devices such as Thyristor, GTO, and IGBT lead to a variety of FACTS Controllers as well as HVDC converters. These Controllers can dynamically line voltage, active and reactive power flow, and control line impedance. They can absorb or supply reactive power and with storage they can supply and absorb active power as well. Figure below show that there are three types of FACTS Controllers. (a) as injection of voltage in series with the line; (b) as injection of current in shunt and the

(c) a combination of voltage injection in series and current injection in shunt. These Controllers have constraint according to the specific type of Controller, its characteristics and rating



(Types of FACTS controller)

Objectives of FACTS controllers

The main objectives of FACTS controllers are the following:

- Regulation of power flows in prescribed transmission routes.
- Secure loading of transmission lines nearer to their thermal limits.
- Prevention of cascading outages by contributing to emergency control.
- Damping of oscillations that can threaten security or limit the usable line capacity

The implementation of the above objectives requires the development of high power compensators and controllers. The technology needed for this is high power electronics with real time operating control. The realization of such an overall system optimization control can be considered as an additional objective of FACTS controllers. FACTS offer solutions to overcome constraints on useable transmission capacity. These constraints may be due to Dynamic conditions like

- Sub synchronous Oscillations
- Dynamic over Voltages and Under Voltages
- Voltage Collapse

Steady State conditions of:

- Undesirable Power Flow
- Excess Reactive Power Flows
- Thermal Limits

Types of FACTS controllers -

(a) Static Synchronous Compensator (STATCOM)

STATCOM is a static synchronous generator operated as a shunt-connected Static VAR Compensator whose capacitive or inductive output current can be controlled independent of the ac system voltage.

(b) Static Var Compensator (SVC)

SVC is a shunt-connected Static VAR Generator or absorber whose output is adjusted to exchange capacitive or inductive current so as to maintain or control specific parameters of the electrical power system (typically bus voltage). SVC is an important FACTS controller already widely in operation. Ratings range from 60 to 600 MVAR.

(c) Thyristor Controlled Breaking Reactor (TCR)

TCBR is a shunt-connected thyristor-switched resistor, which is controlled to aid stabilization of a power system or to minimize power acceleration of a generating unit during a disturbance.

(d) Thyristor Controlled Series Capacitor (TCSC)

TCSC is a capacitive reactance compensator, which consists of a series capacitor bank shunted by a thyristor-controlled reactor in order to provide a smoothly variable series capacitive reactance.

(e) Static Synchronous Series Compensator (SSSC)

SSSC is a static synchronous generator operated without an external electric energy source as a series compensator whose output voltage is in quadrature with, and controllable independently of, the line current for the purpose of increasing or decreasing the overall reactive voltage drop across the line and thereby controlling the transmitted electric power . The SSSC may include transiently rated energy storage or energy absorbing devices to enhance the dynamic behaviour of the power system.

(f) Interline Power Flow Controller (IPFC)

IPFC is a combination of two or more SSSCs that are coupled via a common dc link to facilitate bi-directional flow of real power between the ac terminals of the SSSCs and are controlled to provide independent reactive compensation for the adjustment of real power flow in each line and maintain the desired distribution of reactive power flow among the lines. The IPFC structure may also include a STATCOM, coupled to the IPFC common dc link, to provide shunt reactive compensation and supply or absorb the overall real power deficit of the combined SSSCs.

(g) Thyristor Switched Series Reactor (TSSR)

TSSR is an inductive reactance compensator, which consists of a series reactor shunted by a thyristor-controlled reactor to provide a stepwise control of series inductive reactance

(h) Unified Power Flow Controller (UPFC)

UPFC is a combination of STATCOM and a SSSC which are coupled via a common dc link to allow bidirectional flow of real power between the series output terminals of the SSSC and the shunt output terminals of the STATCOM and are controlled to provide concurrent real and reactive series line compensation without an external electric energy source. The UPFC, by means of angularly unconstrained series voltage injection, is able to control the transmission line voltage, impedance, and angle or, alternatively, the real and reactive power flow in the line.

(i) Generalized Unified Power Flow Controller (GUPFC)

GUPFC can effectively control the power system parameters such as bus voltage, and real and reactive power flows in the lines. A simple GUPFC consists of three converters, one connected in shunt and two connected in series with two transmission lines terminating at a common bus in a sub-station . It can control five quantities, i.e., a bus voltage and independent active and reactive power flows in the two lines.

(j) Inter-phase power controller (IPC)

IPC is a series-connected controller of active and reactive power consisting, in each phase, of inductive and capacitive branches subjected to separately phase shifted voltages. The active and reactive power can be set independently by adjusting the phase shifts and/or the branch impedances, using mechanical or electronic switches.

Table: The role of FACTS controllers in power system operation

Operating problem	Corrective action	FACTS controllers
Voltage limits: Low voltage at heavy load High voltage at low load High voltage following an outage Low voltage following an outage	 Supply reactive power Absorb reactive power Absorb reactive power; prevent overload Supply reactive power; prevent overload	 STATCOM, SVC STATCOM, SVC, TCR STATCOM, SVC, TCR STATCOM, SVC
Thermal limits: Transmission circuit overload Tripping of parallel circuits	 Reduce overload Limit circuit loading	 TCSC, SSSC, UPFC, IPC TCSC, SSSC, UPFC, IPC
Loop flows: Parallel line load sharing Post-fault power flow sharing Power flow direction reversal	 Adjust series reactance Rearrange network or use thermal limit actions Adjust phase angle	 IPC, SSSC, UPFC, TCSC IPC, SSSC, UPFC, TCSC IPC, SSSC, UPFC

Benefits of FACTS controllers

FACTS controllers enable the transmission owners to obtain one or more of the following benefits:

1. Cost: Due to high capital cost of transmission plant, cost considerations frequently overweigh all other considerations. Compared to alternative methods of solving transmission loading problems, FACTS technology is often the most economic alternative.
2. Control of power flow to follow a contract, meet the utilities own needs, ensure optimum power flow, minimize the emergency conditions, or a combination thereof.
3. Contribute to optimal system operation by reducing power losses and improving voltage profile.
4. Increase the loading capability of the lines to their thermal capabilities, including short term and seasonal.
5. Provide greater flexibility in sitting new generation.
6. Reduce reactive power flows, thus allowing the lines to carry more active power.

So FACT controllers can be utilized to increase the transmission capacity, improve the stability and dynamic behaviour or ensure better quality in modern power systems. Their main capabilities are reactive power compensation, voltage control and power flow control.

Internet of Things-Aided Smart Grid

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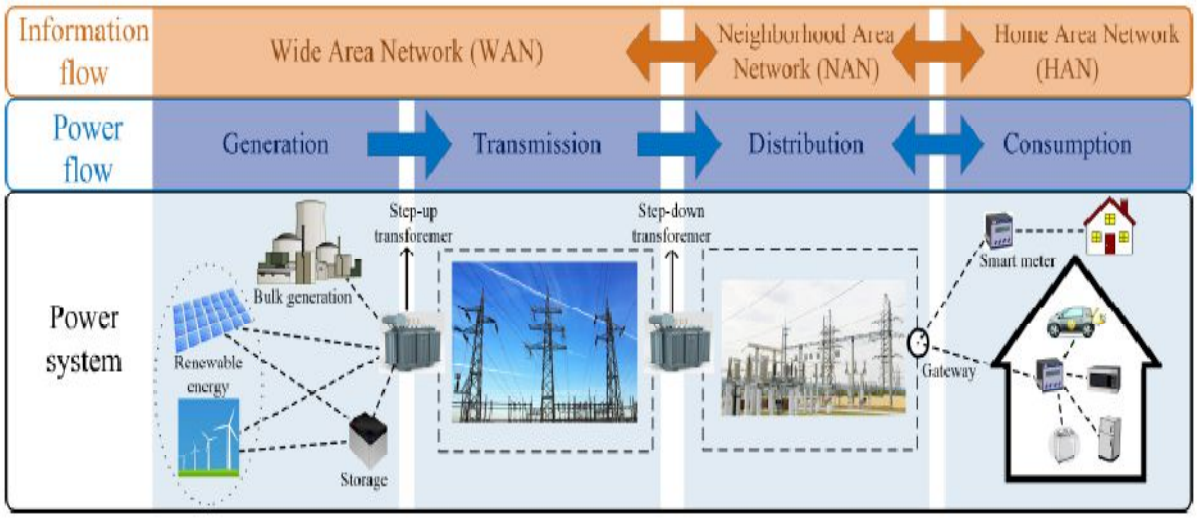
A traditional power grid consists of a large number of loosely interconnected synchronous Alternate Current (AC) grids. It performs three main functions: generation, transmission and distribution of electrical energy in which electric power flows only in one direction, i.e., from a service provider to the consumers. Firstly in power generation, a number of large power plants generate electrical energy, mostly from burning carbon and uranium based fuels. Secondly in power transmission, the electricity is transmitted from power plants to remote load centers through high voltage transmission lines. Thirdly in power distribution, the electrical distribution systems distribute electrical energy to the end consumers at reduced voltage. Each grid is centrally controlled and monitored to ensure that the power plants generate electrical energy in accordance with the needs of the consumers within the constraints of power systems. Nearly, all the generation, transmission and distribution of electrical energy is owned by the utility companies who provide electrical energy to consumers and bill them accordingly to recover their costs and earn profit. The traditional power grid worked very well from its inception in 1870 until 1970. Even though the consumers' demand for energy grew exponentially, it was still rather predictable. However, there has been a dramatic change in the nature of electrical energy consumption since 1970, as the load of electronic devices has become the fastest growing element of the total electricity demand and new sources of high electricity consumption have been developed, such as electric vehicles (EVs). The power grids endure a significant wastage of energy due to a number of factors, such as consumers' inefficient appliances and lack of smart technology, inefficient routing and dispensation of electrical energy, unreliable communication and monitoring, and most importantly, lack of a mechanism to store the generated electrical energy. Furthermore, power grids face some other challenges as well, including growing energy demand, reliability, security, emerging renewable energy sources and aging infrastructure problems to name a few. In order to solve these challenges, the Smart Grid (SG) paradigm has appeared as a promising solution with a variety of information and communication technologies. Such technologies can improve the effectiveness, efficiency, reliability, security, sustainability, stability and scalability of the traditional power grid. SG solves the problem of electrical energy wastage by generating electrical energy which closely matches the demand. SG helps to make important decisions according to the demand of energy, such as real time pricing, self healing, power consumption scheduling and optimized electrical energy usage. Such decisions can significantly improve the power quality as well as the

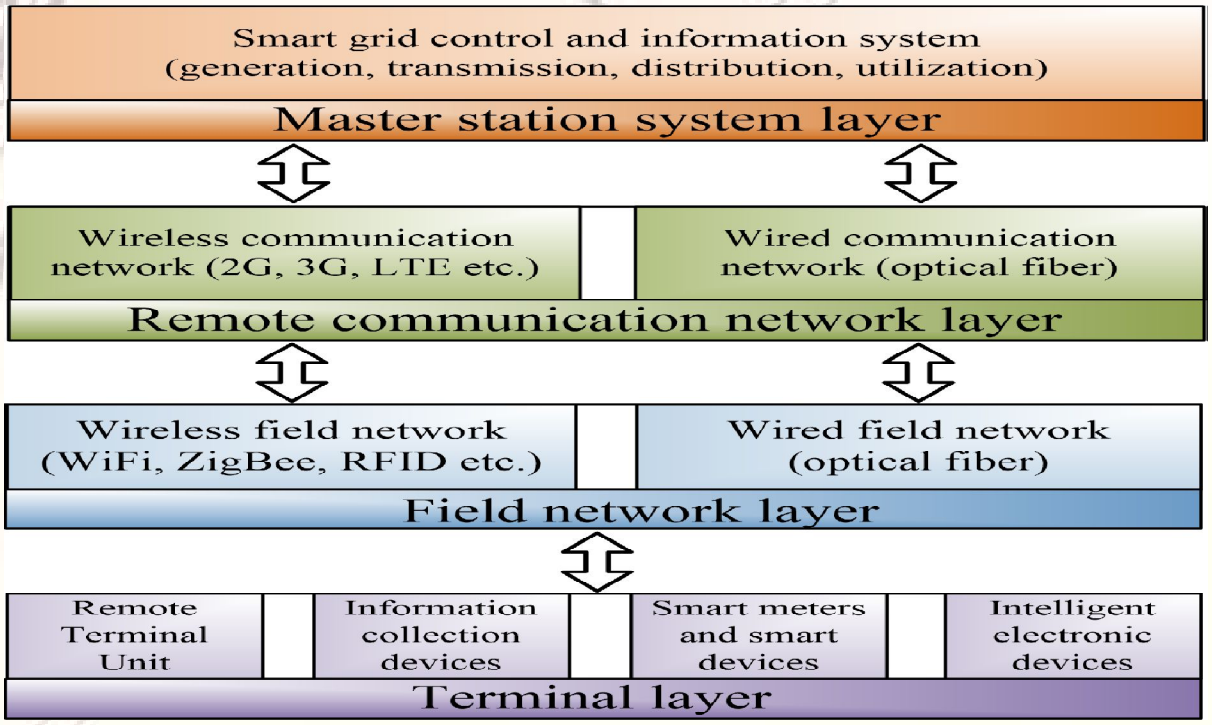
efficiency of the grid by maintaining a balance between power generation and its usage. SG differs from traditional power grids in many aspects. For instance, SG offers a bi-directional communication flow between service providers and consumers, while a traditional power grid only offers only uni-directional communication from the service provider to the consumer. SG provides supervisory control and data acquisition (SCADA), advanced metering infrastructure (AMI), smart meters, fault tolerance, unauthorized usage detection, and load balancing , as well as self-healing, i.e., detection and recovery from faults.

SG deploys various types of devices for monitoring, analyzing and controlling the grid. Such monitoring devices are deployed at power plants, transmission lines, transmission towers and distribution centers and consumers premises. The numbers of such devices is large. One of the main concerns for SG is the connectivity, automation and tracking of such large number of devices, which requires distributed monitoring, analysis and control through high speed, ubiquitous and two-way digital communications. It requires distributed automation of SG for such devices or "things". This is already being realized in the real world through the Internet of Things (IoT) technology.

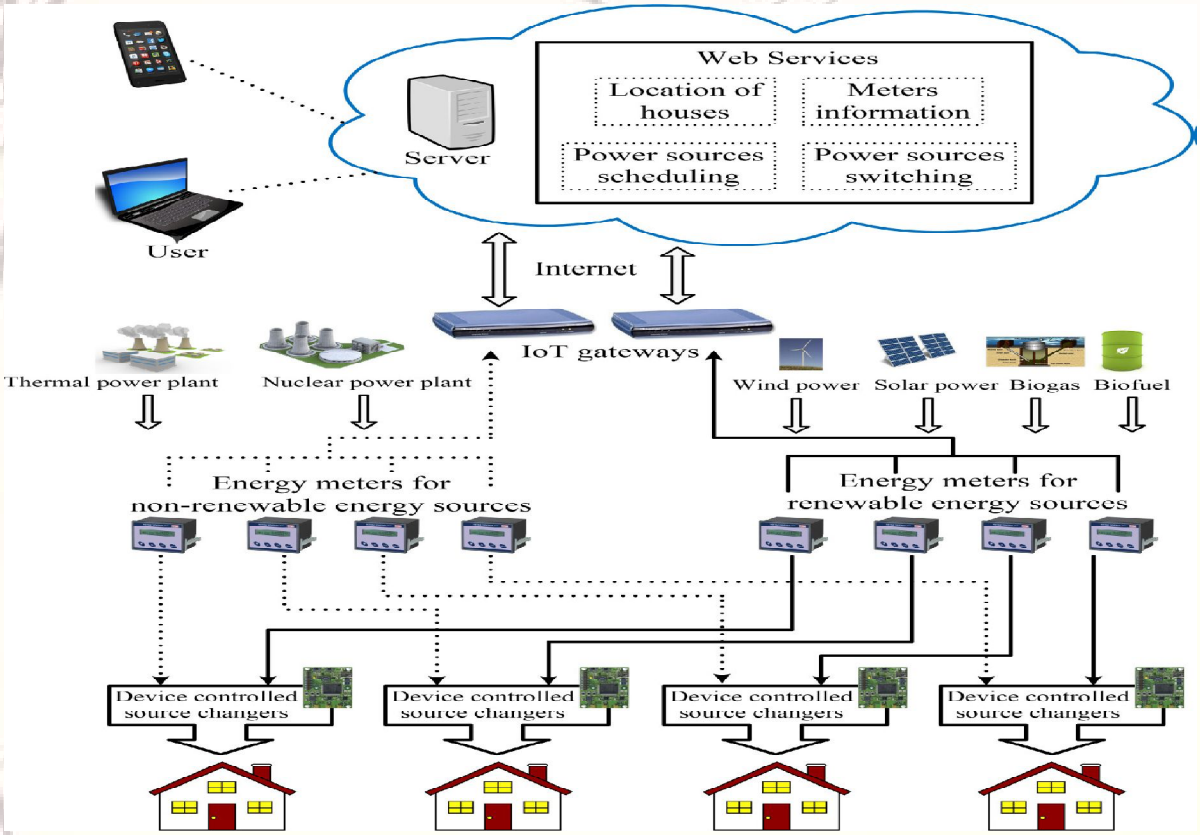
IOT AS A PART OF SMART GRID:-



IOT-AIDED SMART GRID SYSTEM ARCHITECTURE:-



WEB ENABLED SMART GRID ARCHITECTURE:-



BIG DATA AND CLOUD FOR IOT-AIDED SG SYSTEMS

The integration of IoT technology with SG comes with a cost of managing huge volumes of data, with frequent processing and storage. Such data includes consumers load demand, energy consumption, network components status, power lines faults, advanced metering records, outage management records and forecast conditions. This means that the utility companies must have hardware and software capabilities to store, manage and process the collected data from IoT devices efficiently and effectively.

Big data is defined as data with huge volume, variety and velocity (three V's). The high frequency of data collection by IoT devices in SG makes the data size very large. The variety is represented by the different sensors that produce different data. The data velocity represents the required speed for the data collection and processing. Hence, IoT-aided SG systems can apply the techniques of big data management and processing (such as hardware, software and algorithms).

CONCLUSION

Smart Grid (SG) is the future grid which solves the problems of uni-directional information flow, energy wastage, growing energy demand, reliability and security in the traditional power grid. The Internet of Things (IoT) technology provides connectivity anywhere and anytime. It helps SG by providing smart devices or IoT devices (such as sensors, actuators, and smart meters) for the monitoring, analysis and controlling the grid, as well as connectivity, automation and tracking of such devices. This realizes the IoT-aided SG system which supports and improves various network functions at the power generation, transmission, distribution, and utilization.

Transducer: - An Industrial Instrument

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Introduction:-

Instrumentation is the heart of industrial applications. Instrumentation is the art and science of measuring and controlling different variables such as flow, level, temperature, angle, displacement etc. A basic instrumentation system consists of various devices. One of these various devices is a transducer. A transducer plays a very important role in any instrumentation system. An electrical transducer is a device which is capable of converting the physical quantity into a proportional electrical quantity such as voltage or electric current. It converts any quantity to be measured into usable electrical signal. This physical quantity which is to be measured can be pressure, level, temperature, displacement etc. The output which is obtained from the transducer is in the electrical form and is equivalent to the measured quantity.

There are of many different **types of transducer**, they can be classified based on various criteria as

- Types of Transducer based on Quantity to be Measured

  - Temperature transducers (e.g. a thermocouple)
  - Pressure transducers (e.g. a diaphragm)
  - Displacement transducers (e.g. LVDT)
  - Flow transducers

- **Types of Transducer based on the Principle of Operation**

  - Photovoltaic (e.g. a solar cell)
  - Piezoelectric
  - Chemical
  - Mutual Induction
  - Electromagnetic
  - Hall effect
  - Photoconductors

- Types of Transducer based on Whether an External Power Source is required or not

Active Transducer

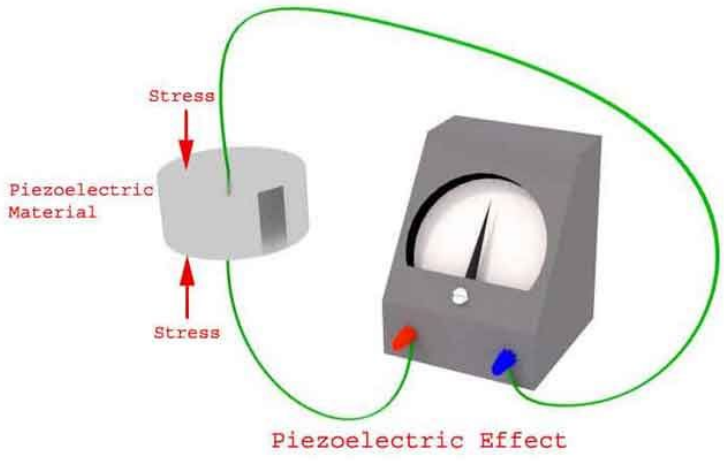
Active transducers are those which do not require any power source for their operation. They work on the energy conversion principle. They produce an electrical signal proportional to the input (physical quantity). For example, a thermocouple is an active transducer.

Passive Transducers

Transducers which require an external power source for their operation is called as a passive transducer. They produce an output signal in the form of some variation in resistance, capacitance or any other electrical parameter, which than has to be converted to an equivalent current or voltage signal.

One of the important transducers used in industrial purposes is piezoelectric transducer

Piezoelectric material is one kind of transducers. We squeeze this material or we apply force or pressure on this material it converts it into electric voltage and this voltage is function of the force or pressure applied to it. The material which behaves in such a way is also known as **piezoelectric Sensor**. The electric voltage produced by **piezoelectric transducer** can be easily measured by voltage measuring instruments, which can be used to measure stresses or forces. The physical quantity like mechanical stress or force cannot be measured directly. Therefore, piezoelectric transducer can be used.

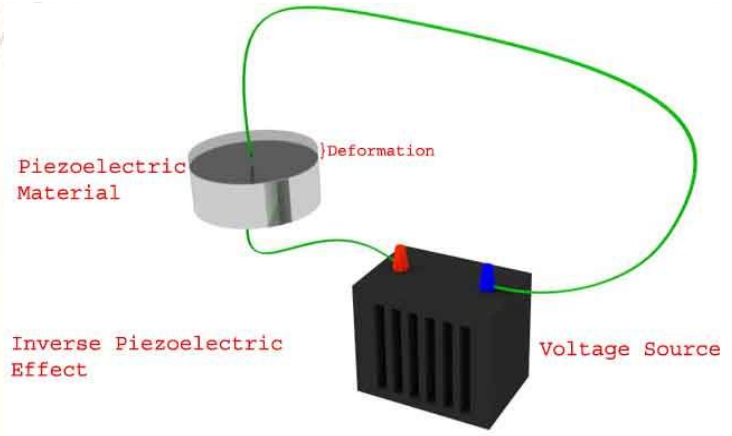


Piezoelectric Effect

Piezoelectric Actuator

Piezoelectric actuator behaves in reverse manner of **piezoelectric sensor**. It is the one in which the electric effect will cause the material to deform i.e. stretch or bend. That means in piezoelectric sensor, when force is applied to stretch or bend it, an electric potential is generated and in opposite when on a **piezoelectric actuator**, an electric potential is applied it is deformed i.e. stretched or bend.

Piezoelectric transducer has high sensitivity. So, it acts as sensor and used in accelerometer due to its excellent frequency of response. The piezoelectric effect is used in many applications that involve production and detection of sound, electronic frequency generation. It acts as ignition source for cigarette lighter and used in sonar, microphone, force, pressure and displacement measurement



Application of Piezoelectric Materials

1. In microphones, the sound pressure is converted into electric signal and this signal is ultimately amplified to produce louder sound.
2. Automobile seat belts lock in response to a rapid deceleration is also done by piezoelectric material.
3. It is also used in medical diagnostics.
4. It is used in electric lighter used in kitchens. Pressure made on piezoelectric sensor creates an electric signal which ultimately causes flash to fire up.
5. They are used for studying high speed shock waves and blast waves.
6. Used in fertility treatment.
7. Used in Inkjet printers

8. It is also used in restaurants or airports where when a person steps near the door and the door opens automatically. In this the concept used is when person is near the door a pressure is exerted persons weight on the sensors due to which the electric effect is produced and the door opens automatically.

Examples of Piezoelectric Material

1. Barium Titanate.
2. Lead zirconatetitanate (PZT).
3. Rochelle salt.

Advantages of Piezoelectric Transducer

1. No need of external force.
2. Easy to handle and use as it has small dimensions.
3. High frequency response it means the parameters change very rapidly.

Disadvantages of Piezoelectric Transducer

1. It is not suitable for measurement in static condition.
2. It is affected by temperatures.
3. Output is low so some external circuit is attached to it.
4. It is very difficult to give desired shape to this material and also desired strength.

Conclusion

A transducer can be used in industry for various purposes by which the physical, mechanical or optical quantity to be measured is transformed directly by a suitable mechanism into an electrical voltage or current proportional to the input measured.

Large Hadron Collider

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Introduction:-

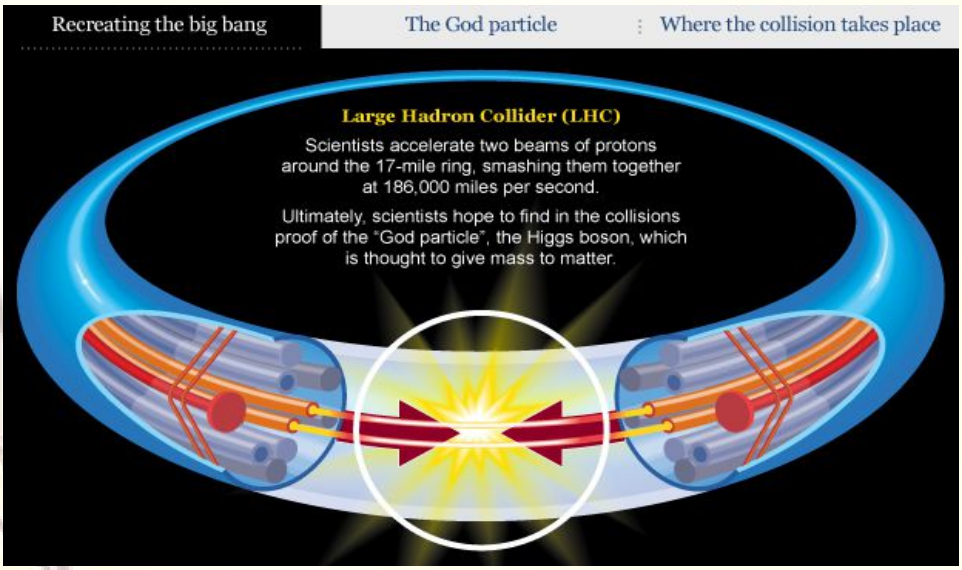
The Large Hadron Collider (LHC) is the world's largest and most powerful particle accelerator which was first started on 10th September 2008, and is the latest addition to CERN's accelerator complex. It consists of a 27 kilometer ring of superconducting magnets with a number of accelerating structures to boost the energy of the particles along the way.

The aim of the LHC is to allow physicists to test the predictions of different theories of particle physics, including measuring the properties of the Higgs boson and searching for the large family of new particles predicted by super symmetric theories, as well as other unsolved questions of physics.

Inside the accelerator, two high-energy particle beams travel at close to the speed of light before they are made to collide. The beams travel in opposite directions in separate beam pipes i.e two tubes kept at ultrahigh vaccum. They are guided around the accelerator ring by a strong magnetic field maintained by superconducting electromagnets.

Thousands of magnets of different varieties and sizes are used to direct the beams around the accelerator. These include 1232 dipole magnets 15 metres in length which bend the beams, and 392 quadrupole magnets, each 5-7 metres long, which focus the beams. Just prior to collision, another type of magnet is used to "squeeze" the particles closer together to increase the chances.

The particles are so tiny that the task of making them collide is akin to firing two needles 10 km apart with such precision that they meet halfway.



CERN Accelerator Complex

The accelerator complex at CERN is a succession of machines with increasingly higher energies. Each machine injects the beam into the next one, which takes over to bring the beam to an even higher energy, and so on. In the LHC—the last element of this chain— each particle beam is accelerated up to the record energy of 6.5 TeV. In addition, most of the other accelerators in the chain have their own experimental halls, where their beams are used for experiments at lower energies.

The brief story of a proton accelerated through the accelerator complex at CERN is as follows:

- Hydrogen atoms are taken from a bottle containing hydrogen. We get protons by stripping electrons from hydrogen atoms.
- Protons are injected into the PS Booster (PSB) at energy of 50 MeV from Linac2.
- The booster accelerates them to 1.4 GeV. The beam is then fed to the Proton Synchrotron (PS) where it is accelerated to 25 GeV.
- Protons are then sent to the Super Proton Synchrotron (SPS) where they are accelerated to 450 GeV.
- They are finally transferred to the LHC (both in a clockwise and an anticlockwise direction) where they are accelerated for 20 minutes to 6.5 TeV. Beams circulate for many hours inside the LHC beam pipes under normal operating conditions.

Protons arrive at the LHC in bunches, which are prepared in the smaller machines.

Large Hadron Collider:-

LHC stands for Large Hadron Collider.

- Large due to its size (approximately 27 km in circumference), Hadron because it accelerates protons or ions, which are hadrons, and Collider because these particles form two beams travelling in opposite directions, which collide at four points where the two rings of the machine intersect.
- Hadrons (from the Greek ‘adros’ meaning ‘bulky’) are particles composed of quarks. The protons and neutrons that atomic nuclei are made of belong to this family. On the other hand, leptons are particles that are not made of quarks. Electrons and muons are examples of leptons (from the Greek ‘leptos’ meaning ‘thin’).
- A collider, where counter-circulating beams collide, has a big advantage over other kinds of accelerator where a beam collides with a stationary target. When two beams collide, the energy of the collision is the sum of the energies of the two beams. A beam of the same energy that hits a fixed target would produce a collision of much less energy. The energy available (for example, to make new particles) in both cases is the centre-of-mass energy. In the first case it is simply the sum of the energies of the two colliding particles ($E = E_{beam1} + E_{beam2}$), whereas in the second, it is proportional to the square root of the energy of the particle hitting the target ($E \propto \sqrt{E_{beam}}$).

The size of an accelerator is related to the maximum energy obtainable. In the case of a collider, this is also a function of the radius of the machine and the strength of the magnetic field that keeps particles in their orbits. The LHC re-uses the 27-km circumference tunnel that was built for the previous big accelerator, LEP. The circumference of the tunnel, magnets, cavities and other essential elements of the machine, represent the main constraints that determine the design energy of 7 TeV per proton beam.

The LHC accelerates two beams of particles of the same kind, either protons or lead ions, which are hadrons. An accelerator can only accelerate certain kinds of particle:

a) They need to be charged (as the beams are manipulated by electromagnetic devices that can only influence charged particles)
b) They must be stable.

This limits the number of particles that can practically be accelerated to electrons, protons, and ions, plus all their antiparticles. In a circular accelerator, such as the LHC, heavy particles such as protons (protons are about 2000 times more massive than electrons) have a much lower energy loss per turn through synchrotron radiation than light particles such as electrons. Therefore, in circular accelerators, to obtain the highest-energy collisions it is more effective to accelerate massive particles. Synchrotron radiation is the name given to the radiation that occurs when charged particles are accelerated in a curved path or orbit. This kind of radiation represents an energy loss for particles, which in turn means that more energy must be provided by the accelerator to keep the beam energy constant.

Why LHC is underground?

The LHC re-uses the tunnel that was built for CERN's previous big accelerator, LEP, dismantled in 2000. The underground tunnel was the best solution to house a 27-km circumference machine because it is cheaper to excavate a tunnel rather than acquire the land to build at the surface. Also, the impact on the landscape is reduced to a minimum. In addition, the Earth's crust provides good shielding for radiation. The tunnel was built at a mean depth of 100 m, due to geological considerations (again translating into cost) and at a slight gradient of 1.4%. Its depth varies between 175 m (under the Jura) and 50 m (towards

Lake Geneva). The tunnel has a slope for reasons of cost. At the time when it was built for hosting LEP, the construction of the vertical shafts was very costly. Therefore, the length of the tunnel that lies under the Jura was minimized. Other constraints involved in the positioning of the tunnel were: } it was essential to have a depth of at least 5 m below the top of the 'molasse' (green sandstone) stratum } the tunnel had to pass in the vicinity of the pilot tunnel, constructed to test excavation techniques } it had to link to the SPS. This meant that there was only one degree of freedom (tilt). The angle was obtained by minimizing the depth of the shafts.

The LHC tunnel is housed 100 m underground, so deep that both stray radiation generated during operation and residual radioactivity is not detected at the surface. Air is pumped out of the tunnel and filtered. Studies have shown that radioactivity released in the air contributes to a dose to members of the public of no more than 10 μSv/year.

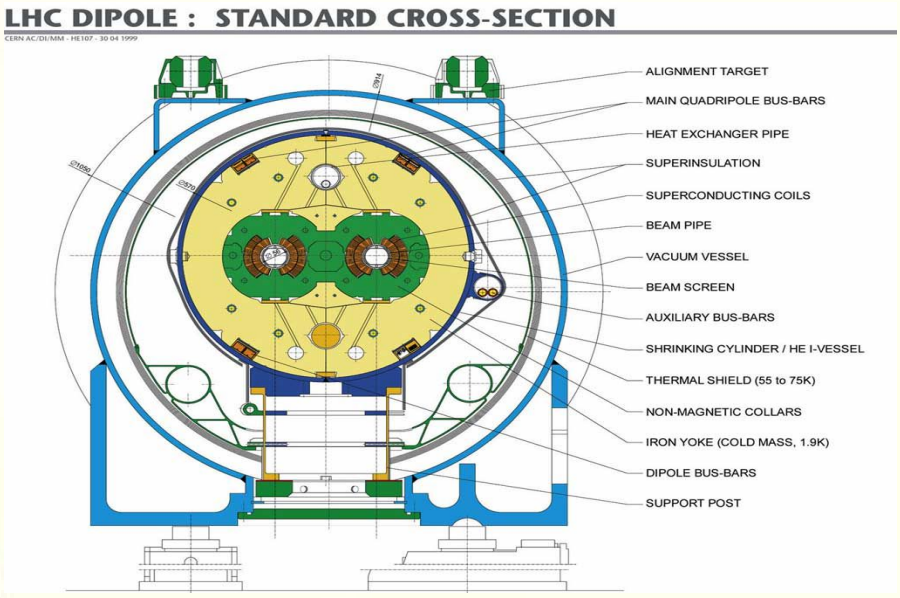
Components of Accelerator:-

In an accelerator, particles circulate in a vacuum tube and are manipulated using electromagnetic devices: dipole magnets keep the particles in their nearly circular orbits, quadrupole magnets focus the beam, and accelerating cavities are electromagnetic resonators that accelerate particles and then keep them at a constant energy by compensating for energy losses.

Vacuum in the LHC: the LHC has the particularity of having not one, but three vacuum systems:

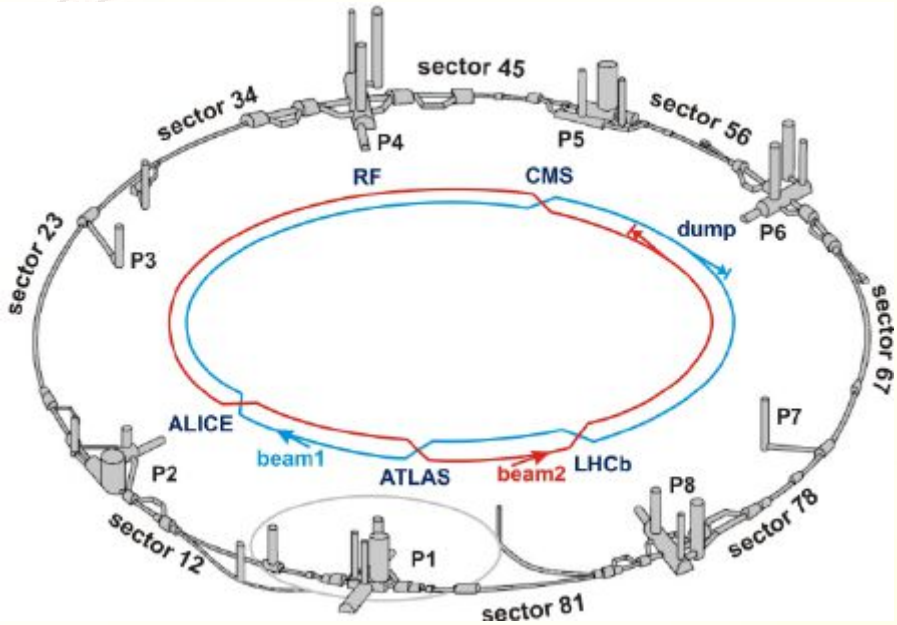
- Insulation vacuum for cryomagnets
- Insulation vacuum for the helium distribution line
- Beam vacuum

The beam vacuum pressure is 10–13 atm (ultrahigh vacuum), because we want to avoid collisions with gas molecules. The largest volume to be pumped in the LHC is the insulation vacuum for the cryo magnets (~ 9000 m3 — like pumping down the central nave of a cathedral!)



Magnets: There is a large variety of magnets in the LHC, including dipoles, quadrupoles, sextupoles, octupoles, decapoles, etc. giving a total of about 9600 magnets. Each type of magnet contributes to optimizing a particle's trajectory. Most of the correction magnets are embedded in the cold mass of the main dipoles and quadrupoles. The LHC magnets have either a twin aperture (for example, the main dipoles), or a single aperture (for example, some of the final-focus triplet quadrupoles). Insertion quadrupoles are special magnets used to focus the beam down to the smallest possible size at the collision points, thereby maximizing the chance of two protons smashing headon into each other. The biggest magnets are the 1232 dipoles.

Cavities: The main role of the LHC cavities is to keep the 2808 proton bunches tightly bunched to ensure high luminosity at the collision points and hence, maximize the number of collisions. They also deliver radiofrequency (RF) power to the beam during acceleration to the top energy. Superconducting cavities with small energy losses and large stored energy are the best solution. The LHC uses eight cavities per beam, each delivering 2 MV (an accelerating field of 5 MV/m) at 400 MHz. The cavities operate at 4.5 K (-268.7ºC)(the LHC magnets uses super fluid helium at 1.9 K or -271.3ºC). For the LHC they are grouped in fours in cryomodules, with two cryomodules per beam, and installed in a long straight section of the machine where the transverse inter beam distance is increased from the normal 195 mm to 420 mm.



Each beam consists of nearly 3000 bunches of particles and each bunch contains as many as 100 billion particles. The particles are so tiny that the chance of any two colliding is very small. When the bunches cross, there are up to 40 collisions between 200 billion particles. Bunches cross on average about 30 million times per second, so the LHC generates about 1 billion particle collisions per second.

A beam might circulate for more than 10 hours, travelling more that 10 billion kilometres, enough to get to the planet Neptune and back again. At near light-speed, a proton in the LHC makes 11 245 circuits every second.

The LHC experiments represent about 150 million sensors delivering data 30 million times per second. After filtering there are several hundred collisions of interest per second. The data flow from all four experiments are several GB/s, producing around 50 000 000 GB (=50 PB) per year, corresponding to a stack of about 10 million standard DVDs, about 12 km tall each year. This enormous amount of data is accessed and analysed by thousands of scientists around the world. The mission of the LHC Computing Grid is to provide a data storage and analysis infrastructure for the entire high-energy physics community that uses the LHC.

- *ATLAS produces about 1 GB/s*
- *CMS produces about 1 GB/s*
- *LHCb produces about 0.6 GB/s*
- *ALICE produces several GB/s during heavy-ion running*

10 Interesting Facts:-

Fact 1) When the 27-km long circular tunnel was excavated, between Lake Geneva and the Jura mountain range, the two ends met up to within 1 cm.
Fact 2) Each of the 6000-9000 superconducting filaments of niobium–titanium in the cable produced for the LHC is about 0.007 mm thick, about 10 times thinner than a normal human hair. If you added all the filaments together they would stretch to the Sun and back six times with enough left over for about 150 trips to the Moon.
Fact 3) All protons accelerated at CERN are obtained from standard hydrogen. Although proton beams at the LHC are very intense, only 2 nano grams of hydrogen*) are accelerated each day. Therefore, it would take the LHC about 1 million years to accelerate 1 gram of hydrogen.
Fact 4) The central part of the LHC is the world's largest fridge. At a temperature colder than deep outer space, it contains iron, steel and the all important superconducting coils.
Fact 5) The pressure in the beam pipes of the LHC is about like the atmosphere of the Moon. This is an ultrahigh vacuum.
Fact 6) Protons at the design energy in the LHC travel at 0.999999991 time the speed of light. Each proton goes round the 27 km ring more than 11 00times a second.
Fact 7) At full energy, each of the two proton beams in the LHC have a total energy equivalent to a 400 t train (like the French TGV) travelling at 150km/h. This is enough energy to melt 500 kg of copper.
Fact 8) The Sun never sets on the ATLAS collaboration. Scientists working on the experiment come from every continent in the world, except Antarctica.
Fact 9) The CMS magnet system contains about 10 000 t of iron, which is more iron than in the Eiffel Tower.
Fact 10) The data recorded by the big experiments at the LHC are enough to fill around 50000 1 TB hard

disks every year.

Conclusion:-

The LHC is the largest machine in the world. It took thousands of scientists, engineers and technicians, decades to plan and build, and it continues to operate at the very boundaries of scientific knowledge.

Development of a Hybrid Power Generation System

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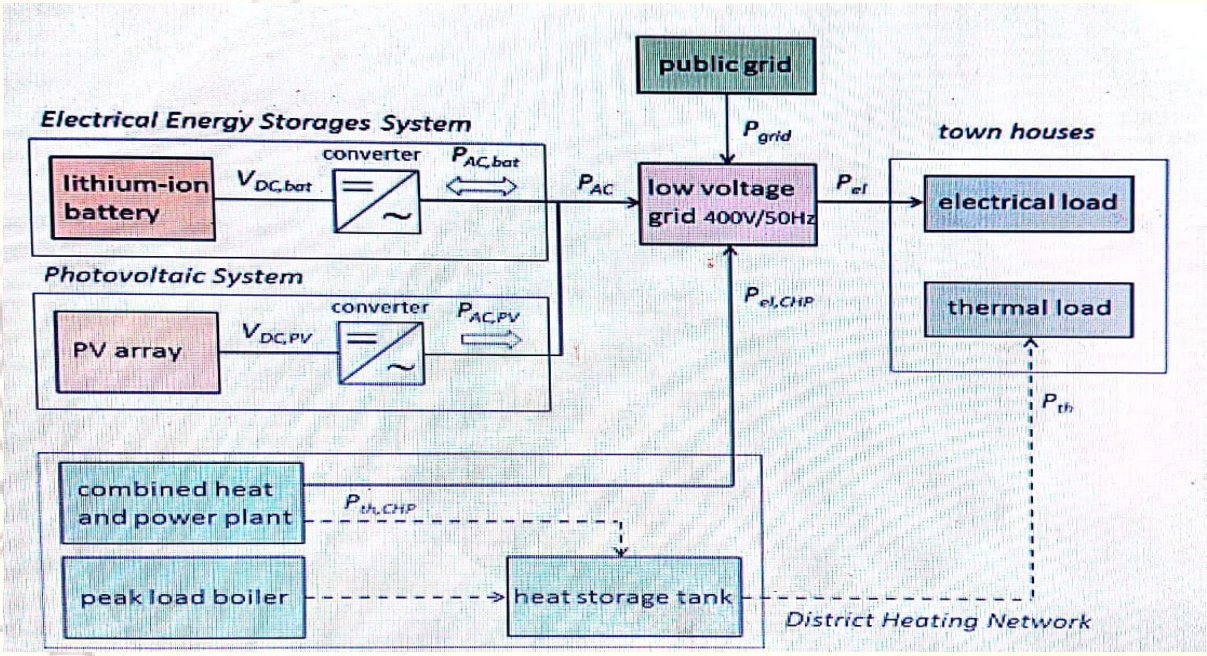
Introduction

As a consequence of the Fukushima reactor catastrophe in the year 2011 the German government has decided an accelerated phasing out of nuclear energy. Up to 2022 a gradual decommissioning of nuclear power plants will take place. Furthermore the goal of a reduction of greenhouse gas emissions by 40 percent by 2020 compared with the base year 1990 was announced by the Federal Minister for the Environment, Nature Conservation and Nuclear Safety, Germany [1]. This goal can only be achieved by the penetration of renewable energy sources, e.g. wind and solar power, [2], [3]. As part of the program "Energiewende" - transforming Germany's energy system a forward-looking approach of a decentralized power generation is currently installed in the town Kelsterbach located in the German Frankfurt/Rhine-Main metropolitan region with a total population of around 3.5 million. The proposed system consists of a combined heat and power plant (CHP) which provides a residential neighborhood with thermal and electrical power. In case of conventional CHP the consumers are supplied with heat together with a peak load boiler to cover the total thermal power demand. In addition a certain amount of electrical power is generated. During periods of heavy consumption additional electrical power is provided by the public grid. The aim of the proposed system is to establish a nearly independent power supply. Therefore a photovoltaic system (PV) is integrated. Due to the fluctuation of the solar power an electric energy storage device is required. Investigations of the electricity storage association ESA show that for photovoltaic applications in the medium power range lithium-ion batteries seems to be the most promising solution [4], [5]. Hence an energy storage system which consists of a lithium-ion pack is used for the proposed application. Fig. illustrates the residential neighborhood which consists of 180 low-energy town houses in accordance with the energy saving regulations KfW efficient house 70 (EnEV 2009). The housing estate was built by Deutsche Reihenhaus AG, a German building enterprise. As indicated in Fig. 1 the power station is located on the left end of the area, it comprises the combined heat and power plant, the peak load boiler and the electric energy storage system. The photovoltaic system will be installed on an anti-noise barrier which separates the housing complex from a railroad line.

System Topology

Fig. shows the block diagram and the energy flows of the proposed hybrid decentralized power generation. In this system a CHP is used which consists of one module with a rated electrical power of $P_{el,CHP} = 50$ kW and a rated thermal power of $P_{th,CHP} = 80$ kW. The annual generated thermal energy is approximately 300000 kWh/a, this leads to about 6000 full load hours. Since the CHP operates always in the heat-controlled mode, these values can vary in dependence on the thermal power demand of the consumers. The thermal power of the installed peak load boiler is 895 kWh. The CHP and the peak load boiler if necessary charge the heat storage tank. The residential neighborhood is supplied with thermal power via a district heating network (dashed line). With this plant design the complete thermal power

demand can be covered. The electrical power of the CHP Pel,CHP is transmitted via a 400V/50 Hz low voltage grid (solid line). To establish a hybrid power generation a PV array as a second electrical energy source will be integrated. The installed peak power depends on the useful area of the anti-noise barrier. In this system the projected peak power is set to 70 kWP. As mentioned above a lithium-ion battery is integrated into the system to compensate the fluctuating solar power. In addition the battery supplies power during power-off durations of the CHP. The DC voltage on the PV panel output VDC, PV varies with the module temperature T and the solar irradiation S, the DC voltage on the output terminal of the battery VDC,Bat varies with the state of charge (SOC). Therefore the PV panel and the battery are linked to the low voltage grid via individual converters. Each converter consists of two power electronics components, first a DC/DC converter which is required for the DC voltage adaption, second a grid tied inverter which converts the DC power into AC power for the low voltage grid. To ensure a charge and discharge of the battery the power flow PAC,bat is bidirectional. To reduce the power flow from the public grid in order to establish a nearly independent power supply an optimized power management will be implemented so that the complete demand of the consumers Pel is covered by the electrical power of the CHP (Pel,CHP) and the PV and battery system (PAC), Pel = Pel,CHP + PAC. In this way the power from the public grid can be minimized, Pgrid → 0.



Design of the electrical energy storage system

The integral part of the decentralized power generation is the CHP. As described in section 2 the design is determined by the requirement to cover the entire thermal power demand of the residential neighborhood. Since the described project is a new housing estate no operation experiences regarding the thermal power consumption exists. In the first phase of the project 120 town houses will be supplied. Therefore load curves of a reference plant are used and scaled to 120 houses. the resulting load curves of the thermal power demand separated into a winter, summer and transition day. Based on this data a CHP with a nominal thermal power of 80 kWh in combination with a peak load boiler with a rated power of 895 kWh are projected. The selected CHP provides a nominal electrical power of 50 kWel. This is not sufficient to

supply electrical power to the town houses. For this reason a hybrid system is supposed with a PV array as a second energy source. The possible peak power which can be installed is determined by the useful area on the anti-noise barrier as explained in section 2. For the proposed hybrid power generation a peak power of 70 kWP is projected. In sum this will result in a theoretical available power of 120 kWel. To evaluate the expected power demand of the consumers standard load profiles are used [6]. The standard H0 load profiles applicable for household customers separated into a winter, summer and transition day for two scenarios. In the first scenario it is assumed that the neighborhood comprises 120 two-person households, in the second scenario 120 four persons households are assumed. The factual power demand will be in between these two boundaries. The maximal power demand varies between 80 kWel and 120 kWel. In particular the highest power demand occurs during the noontime and in the evening hours. It is obviously that the PV system can only generate power during the day.

Consequently an electric energy storage device is required. As mentioned in section 1 for the decentralized power generation a lithium-ion battery is suitable. Two parameters are required for the design of the battery, first the rated power, second the capacity. Taking both scenarios into account the rated power of the battery should be in the range between 30 kWel (a: two-person household) and 70 kWel (b: four-person household). Based on this analysis the rated power of the battery is set to 50 kWel. The required capacity can be determined by the power balance.

It should be taken into account that the PV array supplies power during the daytime. Fig. 6 shows the measured module temperature and solar irradiation of a reference PV array with a peak power of 4 kWP for a cloudless summer day in Frankfurt. The DC power was scaled to a 70 kWP system. These results indicate that sufficient power is supplied by the PV array; however the power varies with the weather and the time of a year. For the design of the battery only the energy demand in the evening time is essential. Taking into account that the power demands of three or four-person households are correspondingly higher a battery with an available capacity of approximately 100 kWh seems to be reasonable for the proposed decentralized power generation.

Analysis of the decentralized power generation

Due to the complexity of this topology a detailed analysis of the operational behavior is required. To date no sufficient experiences exist on the operation of PV systems and lithium ion batteries. Recently published research reports deal with different topics regarding battery storage technologies. However no validated results for a decentralized hybrid power generation in the medium power range are known so far. Thus the goal is to find an optimized operation strategy. To evaluate the energy flows the knowledge of the operational behavior of the subsystems is essential. In this case the energy generation and consumption at different times of a day as well as of different times of a year is of particular interest. This could be established by the use of an applicable simulation model. The advantage of this approach is an easy parameterization of plant data, a variation of environmental conditions and load profiles. For this purpose models of each subsystem are developed which are capable to analyze the dynamic behavior. The standard load profiles are stored in ASCII files which include the thermal and electrical power demand as described in section 3, Pth and Pel, with a sampling interval of 15 minutes. The neighborhood is represented by the consumer model. The thermal power demand Pth is transferred into a power request for the power management. In dependence on the available energy of the heat storage tank Eth the CHP is switched on and off (CHP controller). The electrical power management adjusts PAC so that the demand

Pel is covered by the available electrical power of the CHP Pel,CHP and the converted DC power of the battery and PV array. To achieve sufficient simulation accuracy physical models of the used lithium-ion battery and PV modules have been integrated in the model. In this way the state of charge of the battery for varying operating points as well as the temperature and solar irradiation for varying weather conditions can be considered in the analysis. The model was set up in PSIM.

Conclusion

In this paper a forward-looking technology based on a hybrid decentralized power generation was presented. It was illustrated that a combined heat and power plant together with a photovoltaic installation including an electrical energy storage system is capable to reduce the power supply from the public grid. For the proposed plant a lithium-ion battery was supposed in order to smooth load peaks and to enhance the power supply in case of no direct contribution from the photovoltaic array. An appropriate modeling approach which enables the development of a power management was explained. In particular it was demonstrated how standard load profiles can be utilized to analysis the performance of the power generation system for different seasons. Currently only the combined heat and power plant is in operation. By the end of May 2014 the battery and the photovoltaic system will be installed. The introduced model is helpful to find an optimized operation strategy which will be implemented in the final system

Super Conducting Generators

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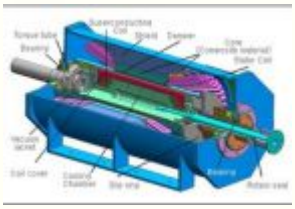
Introduction:-

Superconducting elements are the most important part of electromechanical systems because of their functioning and these systems form the superconducting electric machines. Lack of DC resistance in super conductors contributes much to its greater efficiency.

In a super conducting machine very high magnetic field is produced otherwise impossible in a conventional machine and is the main characteristic of super conductors. High magnetic field results in lesser motor volume and ultimately more power density.

Cryogenics are highly used in super conductors to maintain a specific temperature which is less than the room temperature upto hundred degrees, super conducting transition temperature (Tc), at which the superconductors reach the zero resistance.



Superconducting AC synchronous electric machines which include alternators and synchronous motors have become more common nowadays than before.

The rotor or the rotating member of the machines has an electromagnetic field winding on itself for direct current which employs superconductors.

The stationary member or stator of the machines however utilizes the same old conductors constituting of copper conductors which undergo normal conduction.

An attempt to reduce the resistive loss of the stator conductors they are cooled but the loss is not permanently removed.

Principle

The working principle previously used in old electric generators which included synchronous permanent magnet generators or motors and the induction machines is also being used nowadays in the **superconducting generators**. The only difference between the two is the windings of the superconducting generator. These windings are able to support a more powerful magnetic field as compared to that of conventional generators. Using this coil in other various rotating machines will also improve their efficiency; make them more compact and eco-friendly. The superconducting generators have a coil cover for the coil to support it when under centrifugal force and a damper for protection against high frequency magnetic field. A cooling chamber to maintain ultra-low temperature is also present along with a rotary seal which is a rotary room to provide the cryogenic coolant from. The core is made of non-magnetic stator core plus a stator coil made of copper. The current is applied to the super conducting coil, made of superconducting material, through the slip ring.

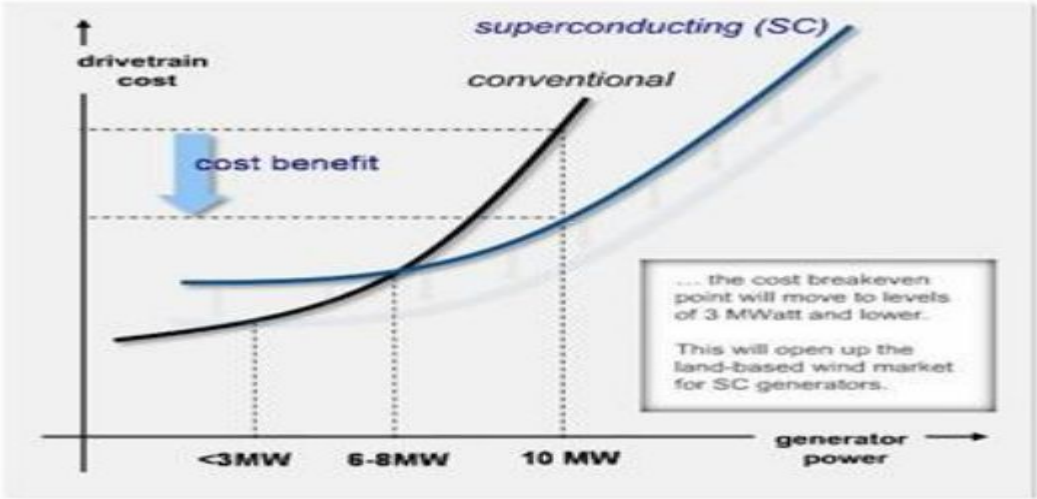
Three insulations are also present, first is the shield to protect the release of magnetic field to the surrounding, second is the vacuum jacket which forms the vacuum insulation layer and last is the torque tube which is the insulating structure.

Industrial Revolution in Energy

Superconductivity technology is not without benefits and its scope and ability is now much understood. The magnetic resonance imaging techs in medicine and super-colliders or particle physics analysis done in research are a few beneficial outcomes of this technology which clearly are upgrading different areas of our society.
The size, cost and efficiency of the production and usage of electricity will also be greatly affected by super conductors.

Comparison between super conductor and conventional tech generators

Cost comparison is done between the generators working on super conducting technology and those working on conventional tech and is shown in the "Superconducting Generator Cost Comparison" chart. The results obtained from the comparison show that the conventional technology costs cheaper when dealing with low power levels. This is so because the cost of copper cable used in the conventional machines is much less than that of the superconducting cable. The cost of superconducting generators also increases because of the use of cryogenics to cool the machine up to a specific temperature while the cooling cost of old generators is much less.



The case is reverse when talking about high power levels. Super conductors become more cost effective at this point because the power per unit of increase becomes more favorable. The break-even point for both generators comes out to be between the ranges of 4-6 MW. It is expected in future that further research and improvement in superconductor production tech and the cooling method through cryogenics will decrease the cost a great deal. The cost utilized for superconducting power generation will also decrease. The break-even point mentioned earlier will also reduce.
If it decreases up to 2 MW, competition for superconducting generators will also decrease.

Positive and negative points of superconducting electric machines

First a few of its positive points as compared to conventional tech are being highlighted. The rotor electromagnet is subject to less resistive loss. The size and weight per power capacity is also decreased regardless of the cooling equipment. Some negative points of this machine are as follows:
The cooling system has greater cost, size, weight and also complications. Once the superconductors exit their superconductive state the generator at once stops working. Chances for instability of the rotor speed are also greater. Lack of the characteristic damping usually found in conventional generators may cause the synchronous speed of the superconductor generator to fluctuate. Either the motor bearings should be separate from the cold rotor or it should be able to tolerate the decreased temperature. To operate a synchronous machine such as the superconductor generator practically, it is important to have access to electronic control. This electronic control leads to harmonic loss in the super cooled rotor of the generator to great extent. The coils used in the superconducting generators or motors have electric resistance to a zero unlike that of the copper coil used in old generators leading to less loss of electrical resistance and so greater efficiency. As the electrical resistance loss is decreased so the heat produced by the machine is also less. This reduces the size and the quantity of the material used for production. Advanced heat and electric insulation along with cryogenic refrigeration technology is required by the superconducting generators plus motors to maintain the low temperature requirement and the functionality of the superconducting coil.
Leading future market is expected from superconducting generators and motors because of its characteristic high energy efficiency and better resource
Utilization ability. It has much resemblance to today's demand of high efficiency and eco-friendly plant.

Eye Tracking

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Introduction:-

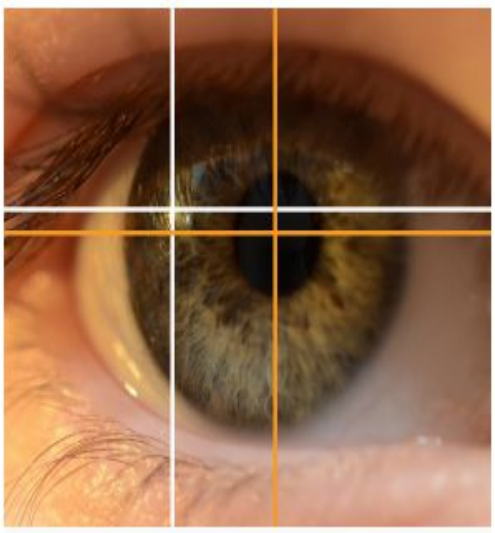
At present human computer interaction has become very important in our daily lives. Smartphone uses fingers as an input source. Eye movements are most frequent of all human movements. Eye movement is fundamental to the operation of visual system therefore the movement of user's eye can provide a convenient and natural source of input.

Eye tracking is the measurement of eye activity. Where do we look? What do we ignore? When do we blink? How does the pupil react to different stimuli?

This involves a process of using sensors to locate features of eyes and estimate where someone is looking.

The process of eye tracking data is collected using either a remote or head-mounted 'eye tracker' connected to a computer. While there are many different types of non-intrusive eye trackers, they generally include two common components: a light source and a camera. The light source (usually infrared) is directed toward the eye. The camera tracks the reflection of the light source along with visible ocular features such as the pupil. This data is used to extrapolate the rotation of the eye and ultimately the direction of gaze. Additional information such as blink frequency and changes in pupil diameter are also detected by the eye tracker. The aggregated data is written to a file that is compatible with eye-tracking analysis software such as **Eye Works**

Most modern eye trackers utilize near-infrared technology along with a high-resolution camera (or other optical sensor) to track gaze direction. The underlying concept, commonly referred to as Pupil Center Corneal Reflection (PCCR), is actually rather simple. It essentially involves the camera tracking the pupil center, and where light reflects from the cornea. An image of how this looks like is on the right.



The accuracy of eye movement measurement heavily relies on a clear demarcation of the pupil and detection of corneal reflection.
The visible spectrum is likely to generate uncontrolled specular reflection, while illuminating the eye with infrared light - which is not perceivable by the human eye - renders the demarcation of the pupil and the iris an easy task – while the light directly enters the pupil, it just reflects from the iris. This means that a clear reflection is generated (with little noise) and can therefore be followed with ease.

Pupil Centre Corneal Reflection (PCCR). The light reflecting from the cornea and the centre of the pupil are used to inform the eye tracker about the movement and direction of the eye.
Near-infrared light is directed toward the center of the eyes (the pupils) causing visible reflections in the cornea (the outer-most optical element of the eye), which are tracked by a camera.

Here are 8 applications of Eye Tracking that are being used today:

1. Website Usability Testing- Computers have become a primary source of information; therefore, it is critical that users be able to easily locate and comprehend information on a user interface. Eye tracking is often used by Web designers and Usability Specialists to identify which elements of websites function as intended and which need to be revised.

2. Advertising and Marketing Research- Another growing application for eye tracking is in the marketing industry. Advertisers are evaluating the effectiveness of their campaigns, using eye tracking to determine if customers are noticing the key elements in a product placement, commercial, or print ad.

3. Assistive Technology- both wearable and monitor mounted eye trackers are being used by disabled individuals for communication and computer control. With most of these products, eye tracking permits eye movement to replace the traditional keyboard and handheld mouse.

4. Digital and Operational Training Scenarios- Eye tracking is used in different types of simulators, including driving, flight, and even operating room, to track the eye movements of trainees as they perform tasks. Military and law enforcement agencies have also used eye tracking in the field.

5. Human Behavior- One of the most common applications of eye tracking in research is studying patterns of eye movements and their correlation with different behaviors. There is much to be discovered about how visual behavior relates to cognition and decision-making.

6. Developmental Psychology- Infants communicate and take in information about their world through their eyes before they can speak. Eye tracking can get an up close look at how babies perceive their surroundings and how visual behavior impacts their development.

7. Human Factors Research- Eye tracking is often used to monitor and research how people interact with their environment, particularly with respect to equipment and machinery. Human factors research seeks to improve efficiency, operational performance, and safety, as humans engage with their technical and environmental surroundings.

8. Neuroscience and Diagnostics- It has been discovered that certain oculometrics, only traceable with eye tracking, could be potential indicators of neurological conditions. Research is being conducted to

determine if eye tracking may be an accurate tool for identifying signs of Traumatic Brain Injury, autism, and ADD.

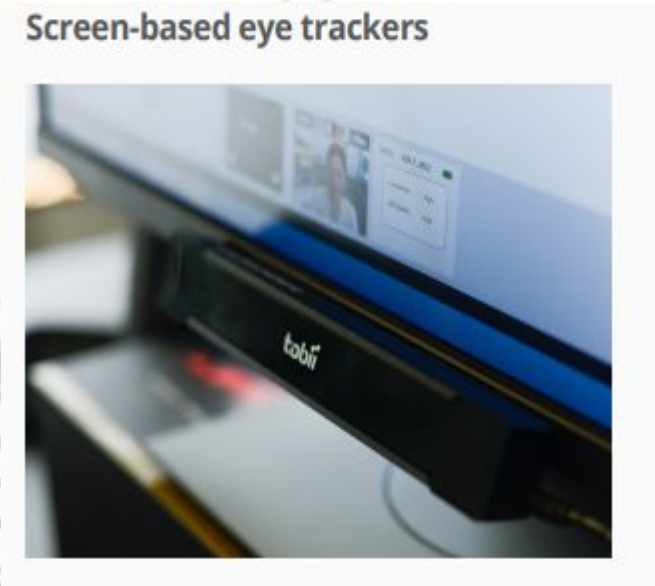
Eye tracking is no longer a niche technology used by specialized research laboratories or a few select user groups but actively exploited in a wide variety of disciplines and application areas. It is becoming an increasingly interesting option even in traditional computing. Major technology companies and the gaming industry are starting to show growing interest in embedding eye tracking in their future products, such as laptops and tablets.

Eye Tracking Devices:-

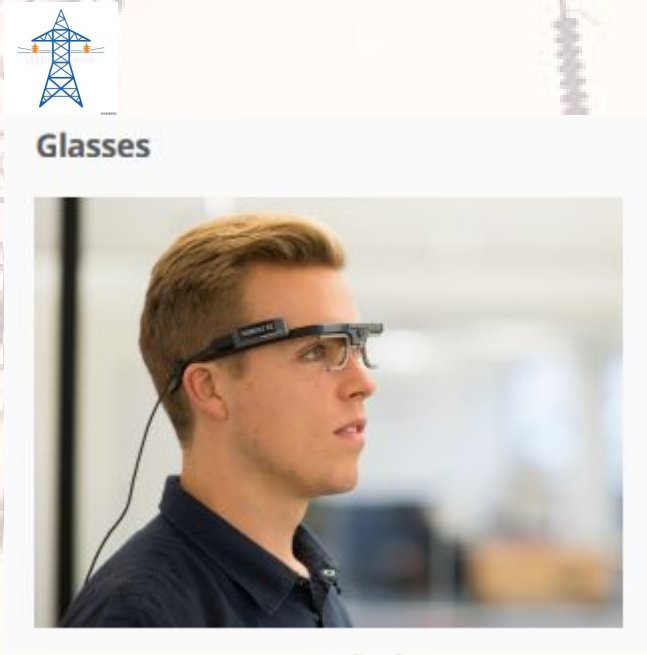
There are two types of eye tracker:

(I). Screen-based (also called remote or desktop)

(II). Glasses (also called mobile).



- Record eye movements at a distance (nothing to attach to the respondent)
- Mounted below or placed close to a computer or screen
- Respondent is seated in front of the eye tracker.
- Recommended for observations of any screen based stimulus material in lab settings such as pictures, videos, websites, offline stimuli (magazines, physical products etc.), and other small settings (small shelf studies etc.)



- Records eye activity from a close range.
- Mounted onto lightweight eyeglass frames.
- Respondent is able to walk around freely.
- Recommended for observations of objects and task performance in any real-life or virtual environments (usability studies, product testing etc)

Limitations Of Eye Tracking:-

Eye motion is tightly linked to visual attention. As a matter of fact, you just can‘t move your eyes without moving attention. You can however certainly shift attention without moving your eyes. While eye tracking can tell us what people look at and what they see, it can’t tell us what people perceive.

Eye tracking gives incredible insights into where we direct our eye movements at a certain time and how those movements are modulated by visual attention and stimulus features (size, brightness, color, and location).

M-Voting – An alternative of e-voting

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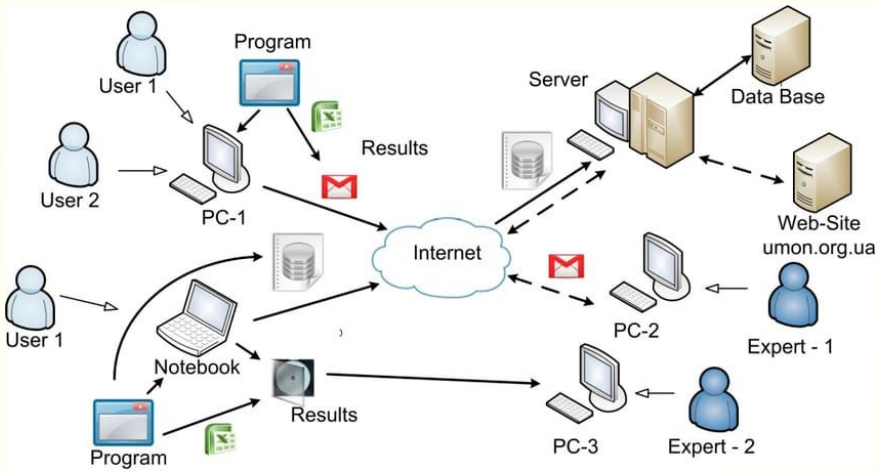
- Mobile technology has attained heights and the market trend is that every citizens of India will possess a mobile handset by the year 2010 (at cheaper rates of service.) When such a PDA is available why not using it for a time saving, cost effective, secured method of voting.
- The concept is as follows:
- Every citizen above the age of 18 years has got the right to vote and hence obtaining their fingerprints and storing in the database along with their birth/death record becomes necessary.
- User sends his finger print (secured print is encrypted and sent as sequence of data in encoded form) to the service provider.
- Service provider verifies the fingerprint and checks for the validity of voting and sends voter list (a mobile ballot paper) through SMS.
- User casts his vote and sends 2nd message.
- Since mobile phone has connectivity with computer systems it is easy to store and access at the service provider and results be published instantly.

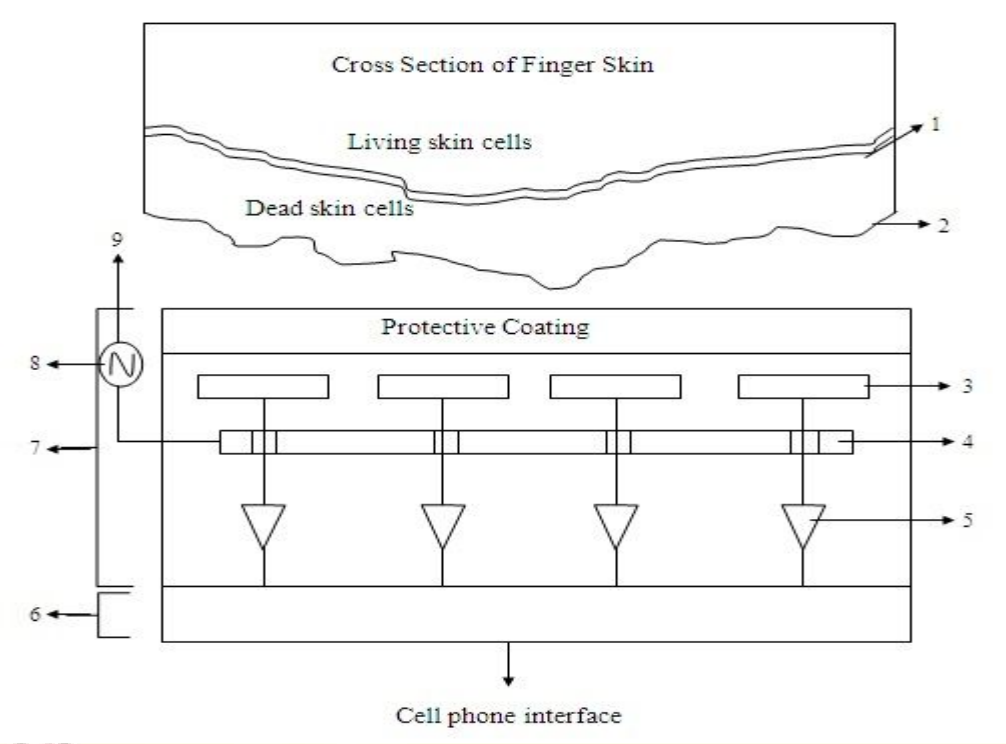


Finger print sensor:

- The Finger Loc sensor is mono lithic silicon chip comprising a sensing array and its associated circuitry, all covered by a fairly thick (75 micro metre) proprietary coating. It can be easily embedded in the surface of a cell phone, where the robust coating will protect it from the rigors of normal usage. Finger Loc' key advantage over other (optical) fingerprint sensors, is that it ignores the external fingerprint in a buried layer of living cells, where fingerprints are created, and where they are found in pristine condition.

- What it does is apply a low-voltage ac signal to the fingertip and then measure how the resulting electric field varies in amplitude over the fingertip surface. The signal is applied by means of a conductive epoxy ring surrounding the sensor area. It is defined and measured with respect to a reference plane within the chip. The electric field is set up between the reference plane and a thin layer of highly conductive saline liquid that resides at the interface of the living skin tissue and the dead skin. The saline layer has same shape as the living tissue- the shape of the fingerprint. Being highly conductive, it imposes its shape as a boundary condition on the field, thereby spatially modulating the field into an analog of the fingerprint.
- An array of tiny antenna arranged in a square matrix of 96 rows and columns does the actual sensing. Located above the reference plane, the array measures about 6.5mm on a side, giving the sensor a linear resolution of about 15 pixels per millimeter. The sensed analog electric field values are scanned from the sensor matrix a row at a time, digitized, and sent from the Finger Loc chip to the cell phone's microprocessor for further processing. In the cell phone, a module from a special software suite analyzes the fingerprint pattern and extracts information from it, which it converts into a unique representation of the fingerprint owner's. To register a voter, that representation, called a template, is stored in nonvolatile memory and in storage of Service Provider for instance VSNL for future use.
- What happens next depends on how the cell phone manufacturer and service provider have set things up. If the handset does not recognize the applicant, service will be denied. It gets more interesting when the system does recognize the fingerprint, because each user can have a stored profile, which personalizes the phone for him or her.

Finger Loc Sensor

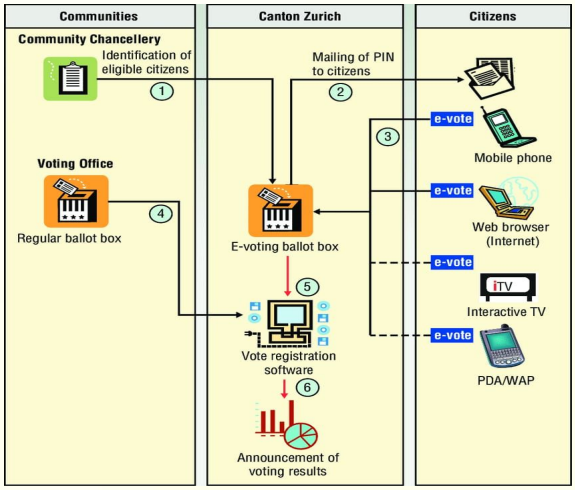


SMS MESSAGE MARKETING

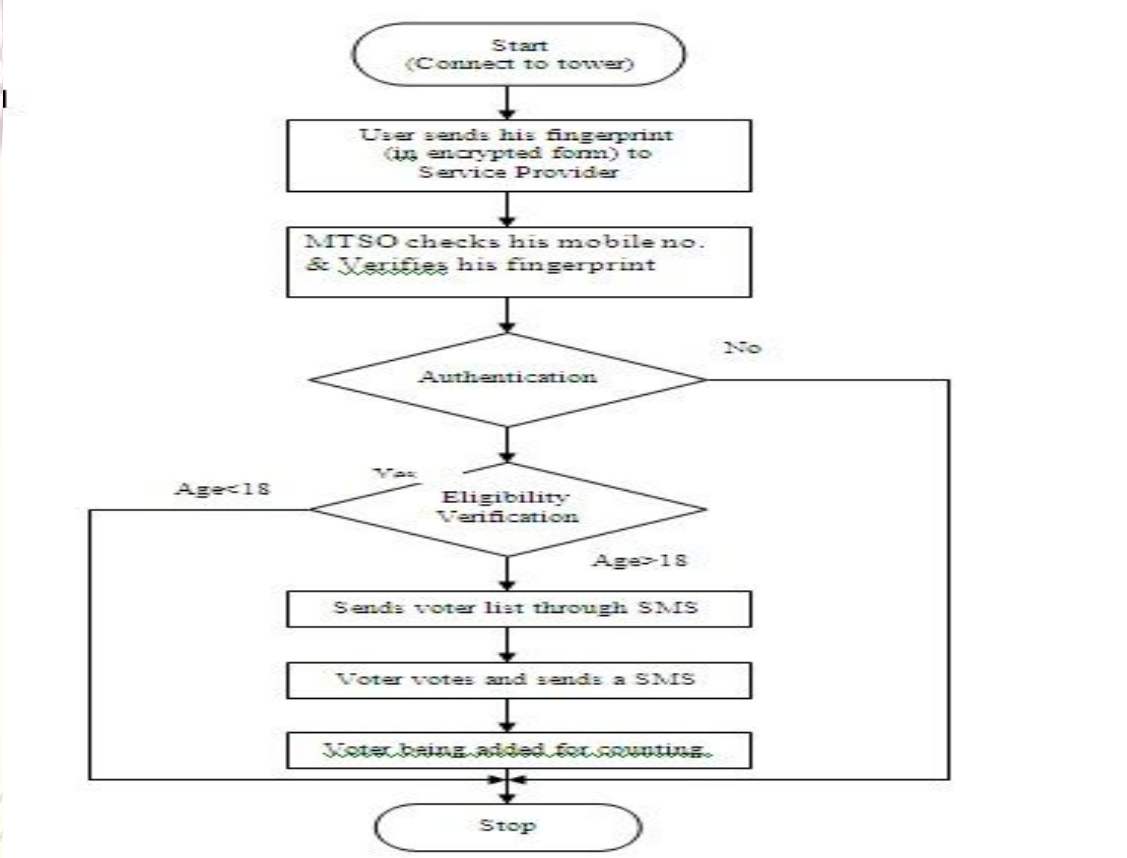
- When the use of mobile phones rises to unprecedented heights, it gave birth to the new technology of short message service. Also known as text messages, Short Message System as a type of mobile service allows the sending of short messages between mobile phones and even allows interacting with automated systems. After a few years of the widespread use of SMS in Europe and Asia, mobile phone service providers in the United States of America started to interconnect their networks for text messaging, thus allowing subscribers on different networks to exchange text messages by the month of November, year 2001.
- The United States overcame unique challenges in combining networks running different technologies, and enabled truly open text messaging possible across all networks. These instances gave birth to a profoundly simple form of mobile marketing via text message or short message service. Text messaging is a text-only message delivery system on mobile phone networks. Text messages travel through the wireless service provider's network, like that of a voice call. The use of mobile phones through texting is now considered as wonderful a part of the innovative world of mobile marketing.
- SMS or Short Message Service is an essential tool in mobile marketing. SMS Message Marketing contributes a lot to the innovation of the mobile world. SMS Message Marketing connects companies to their customers in a fast and easy way. The process of this type of mobile marketing ensures the delivery of the message, since a short message service center is responsible for the storage and delivery of the message to its destination. To be specific, through the SMS center, a user sends a text message (SMS message) to another user, and the message gets stored in the SMS center, which delivers it to the destination user when they are available. In addition, if the customer's/recipient's mobile phone is turned off or is out of range, the message will be delivered at the next opportunity.
- SMS Message Marketing offers a wide variety of mobile services. In fact, it is widely used for promotions, campaigns, voting, polling, surveys, and many more. SMS Message Marketing is also considered as a two-way communication, cost effective, instant, direct, fast, and effective as it is usually targeted to a particular age, gender or even profession. SMS Message Marketing is also an essential tool in building a desirable relationship between the companies or businesses and the customers, in such a way that the responses of the customers are taken into consideration while the companies or businesses can gain feedbacks on how to improve their products as well as ideas about the preferences of their customers. A mobile originated message, inherently, requires the express consent of the customer to receive future communications. In addition to this, the customers initiate the communication by responding to the businesses' text message or SMS.
- SMS Message Marketing is, indeed, a great tool in the field of marketing. It has proven to be a helpful tool in the world of mobile industry. In addition to this, SMS Message Marketing is used by a number of various entities, like party promoters and personal relations firms, companies that want to talk with their customers, marketing agencies as a bonus campaign feature, and retailers who want to attract their customers.
- SMS Message Marketing features a variety of requested services such as voting in contests, favorite television shows or radios; sweepstakes; text polls and surveys; chats and fan clubs

forum; product data and/or information; text dating or match-making; text coupons and/or discounts; games of single-player or multi-player; sports information, news and/or weather reports; recipes and menus; donations; and requested services to customized mobile phones with logos, wallpapers, ring tones, music and many more. These requested services are made possible by sending the mobile short codes through the use of text messaging.

- The SMS Message Marketing also allows a one to one marketing ability by sending alert messages and notifications with a double opt-in subscription service, and thus saves time and money by helping businesses or companies target an audience more efficiently. In addition to this, SMS Message Marketing provides a real-time interaction between the businesses and the customers; therefore it keeps the conversation ongoing.
- SMS Message Marketing has been helpful in the field of advertising, commerce, entertainment, and marketing. Nowadays, SMS Message Marketing is widely used as a voting tool for television shows. In fact, through the recent addition of Cingular-powered SMS voting on the television program American Idol, SMS Message Marketing has started to be introduced into the United States.
- SMS Message Marketing makes it easy for businesses to reach the customers in real-time wherever they are. With SMS Message Marketing, it makes it easy for companies to aim for their specific customers. Customers, in return, would experience a convenient way of great access to their favorite mobile contests, coupons, voting, donations, news reports, weather forecasts, sports news, and their desired mobile services. SMS Message Marketing opens a wide opportunity of interactive experience the interactive way of life. SMS Message Marketing is a successful product of a fast-growing modern technology. One can enjoy the advantages of SMS Message Marketing anytime and anywhere. SMS Message Marketing is a two-way advantage to the customers as well as the companies or businesses.
- Through the years, SMS Message Marketing has become considered as a successful form of mobile marketing. Aside from keeping people in touch, SMS Message Marketing makes it possible to continue the growth of marketing through sheer text messaging. People from different countries will carry on enjoying the benefits that SMS Message Marketing provides as companies continue to develop their business. SMS Message Marketing makes life more exciting, lively, fun, entertaining and happy. Additionally, one can send messages to participate in polls, voting, games and a variety of other exciting mobile applications by addressing the SMS or text message to a short code.



PROCESS FLOW CHART



PROS AND CONS

Pros:

- Cost effective i.e. no need for dedicated voting machines, which are vulnerable and used
- Once in five years.
- User- friendly easy access for citizens.
- Most secure voting ever.
- Fake votes easily avoided.
- Time consumption is very less.
- My vote goes mobile.

Cons:

- Service provider needs to be governmental organization.
- Service provider must have high-speed equipments.
- Citizens should contact correct SMS number in order to avoid false voting.
- Presently non-availability of sensors in Mobile Phones.

Planning a Digital Marketing Campaign

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Introduction:-

Digital marketing is the marketing of products or services using digital and any other digital medium. Digital marketing's development since the 1990s and 2000s has changed the way brands and businesses use technology for marketing. As digital platforms are increasingly incorporated into marketing plans and everyday life, and as people use digital devices instead of visiting physical shops, digital marketing campaigns are becoming more prevalent and efficient.

Digital marketing methods such as content marketing, influencer marketing, content automation, campaign marketing, data-driven marketing, e-commerce marketing, social media marketing, social media optimization, e-mail direct marketing, display advertising, e–books, and optical disks and games are becoming more common in our advancing technology. In fact, digital marketing now extends to non-Internet channels that provide digital media, such as mobile phones (SMS and MMS), callback, and on-hold mobile ring tones etc. Articulation of clear Business Objectives of digital marketing programme – such as Increase brand awareness, increase sales, increase customer retention, reduce cost per lead, reduce cost per acquisition of customers – these are all standard business objectives but on their own they do not give you a pathway to implement them digitally – that's why one have to dig down and go beyond these in a digital sense.

Next step is to deconstruct these business objectives down into digital goals. So for example lets choose 'increase sales' – if anyone want to translate that into a coherent digital goal – it would look something like: increase the conversion rate on any website, reduce cart abandonments on checkout process, increase average order size on etc. – digital goals give the plan a clear direction – one can then start to adopt tactics that will deliver these 'Digital Goals'.

Once we know what our digital goals are, then we can define what our main Key Performance Indicators are which map on to these Digital Goals – e.g. for reducing cart abandonment rates – the Digital KPI should be the abandonment rate goal tracked in our analytics software that tracks how many users enter the funnel (proceed to checkout) and ultimately get to the end of it (complete checkout and payment).

At this stage, one can then start projecting some nominal KPI targets – for instance, increase conversion rate from 1 to 1.5% – increase average order size from €45 to €55 – the digital plan then becomes how we are actually going to deliver these goals and projections through digital channels.

Once we have the objectives, digital goals, KPIs, and targets set – then we can start fleshing out our strategy and the main part of this will be clearly defined audience segmentation: i.e. to develop rich personas (target audience). By rich I mean that they are fully fleshed out – one should articulate the problems that a business solve for specific types of persona, their needs (emotional, lifestyle, informational) where they digitally coalesce, media preferences, perceptions they have business/brand etc. When defining our target audience give them as much detail as possible – it will be worth its weight in gold when we start trying to communicate with them.

For each of these Personas then develop a clear Value Proposition for our business and how it relates to them – and by that we mean, clearly articulate and answer the question, "If I am your ideal customer, why should I purchase from you over one of your competitors?"

Once we've identified our personas, then we can research, based on their informational and geographical needs as well as their digital behaviors, the correct and most appropriate digital channels to target them on

This is where we then go into great detail on our digital channel strategy – be that Display, Email, Social, Affiliate, Mobile etc. I recommend strongly in this section that we break up your tactical solutions into: Customer Reach, Customer Acquisition, Customer Retention or some variation of this – essentially map the Digital channels on to the Sales/Buyer Cycle.

And finally, define how we will measure all of this – for each of the channels we should have a clear measurement framework in place where we can measure the effectiveness of each of the channels and produce a matrix of core metrics that indicate whether we are on track to meet targets or not

Digital marketing is the best platform to convert a product to a brand. Because it is more cost effective and it provides lot of touch points to marketer. Brands can able to engage their target group in an effective way through digital platforms. Digital media is not only for engagement, brands can increase their customers or they can retain their existing customers. Digital platforms help to increase the impact of brand recall in target groups.

I conclude my topic by quoting again that "Brands must pursue digital platform".

Circuit Breaker Maintenance by Mobile Agent Software Technology

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Circuit breakers are crucial components for power system operations. They play an important role in switching for the routine network operation and protection of other devices in power systems. To ensure circuit breakers are in healthy condition, periodical inspection and preventive maintenance are typically performed.

New maintenance techniques and methodologies are emerging, while the circuit breakers keep improving in their designs and functions. As an example, some new circuit breakers have embedded monitoring instruments available to measure the coil current profiles and the operation timing. The recorded information can be used to monitor the condition of breakers during each operation. In this case, it may be more appropriate to replace the time-directed maintenance by condition-directed maintenance practice. Since the number of circuit breakers in a power system is usually very big, a small maintenance cost saving per each circuit breaker can accumulate to a considerable benefit for the whole system.

An information access method that is capable of handling heterogeneous information sources will be helpful to achieve the above goal. Also, the new information access method should be secure and able to work on unreliable public networks.

The mobile agent software provides a flexible framework for mobile agent applications. An agent application program can travel through the internet/intranet to the computers where the mobile agent server or transporter is running. The mobile agent software also supports Distributed Events, Agent Collaboration and Service Bridge. The mobile agent software may fit very well in the circuit breaker maintenance scenario. In this paper, we considered how mobile agent software might be applied in circuit breaker maintenance and monitoring from the viewpoint of the maintenance crew.

CIRCUIT BREAKER MAINTENANCE TASKS

The maintenance of circuit breakers deserves special consideration because of their importance for routine switching and for protection of other equipment. Electric transmission system breakups and equipment destruction can occur if a circuit breaker fails to operate because of a lack of a preventive maintenance. The need for maintenance of circuit breaker is often not obvious as circuit breakers may remain idle, either open or closed, for long periods of time. Breakers that remain idle for six months or more should be made to open and close several time in succession to verify proper operation and remove any accumulation of dust or foreign material on, moving parts and contacts.

The circuit breakers mainly consist of the interrupter assembly (contacts, arc interrupters and arc chutes), operating mechanism, operation rod, control panel, sealing system, and breaking medium (SF6, oil, vacuum and air). To ensure the performance of a circuit breaker, all the components should be kept in

good condition; therefore time-directed preventive maintenance has been widely adopted. The maintenance practices can be divided into three categories: corrective maintenance, preventive maintenance, and predictive maintenance.

The different strategies are summarized in Table .

(Maintenance Strategies)

Strategy	Description
Run-to-failure maintenance (Corrective, repair only)	The repair and restoration of equipment or components that have failed or are malfunctioning and are not performing their intended function
Time-directed maintenance (Preventive)	The periodic and planned maintenance actions taken to maintain a piece of equipment within the expected operating condition. It extends the equipment life and is performed prior to equipment failure to prevent it. This includes technical specification surveillance, inservice inspection, and other regulatory forms of preventive maintenance
Conditiondirected maintenance (Predictive)	The continuous or periodic monitoring and diagnosis in order to forecast component degradation so that as needed planned maintenance can be performed prior to equipment failure. Not all equipment conditions and failure modes can be monitored; therefore, predictive maintenance must be selectively applied.

Since the maintenance information is distributed among different systems, a software technique that has the flexibility of interfacing with multiple heterogeneous information systems is desired.

MOBILE AGENT SOFTWARE

There are different definitions of what is a software agent. An agent is a proactive software component, which is capable of acting reasonably to accomplish tasks on behalf of the user. An agent should be autonomous and have sound intelligence. Agent-based programming offers greater flexibility and adaptability than component-based programming.

Agents communicate with each other by passing messages or by synchronization. Depending on their functions, we can classify agents into several categories like Personal agents, mobile agents, collaborative agents, etc. Mobile agents are small software entities that can travel around the network, performing their functions on behalf of users. As the next generation middle-ware infrastructure for developing distributed applications, it meets all the requirements mentioned above. The mobile agent server can run on any

platform where the Java runtime environment is available, and the devices without Java Virtual Machine (JVM) are supported through a communication node.

APPLICATION SCENARIOS

To reflect the distributed characteristic of the data sources, three computers are used to represent the enterprise maintenance system, the substation concentrator and the maintenance crew respectively as shown in Figure

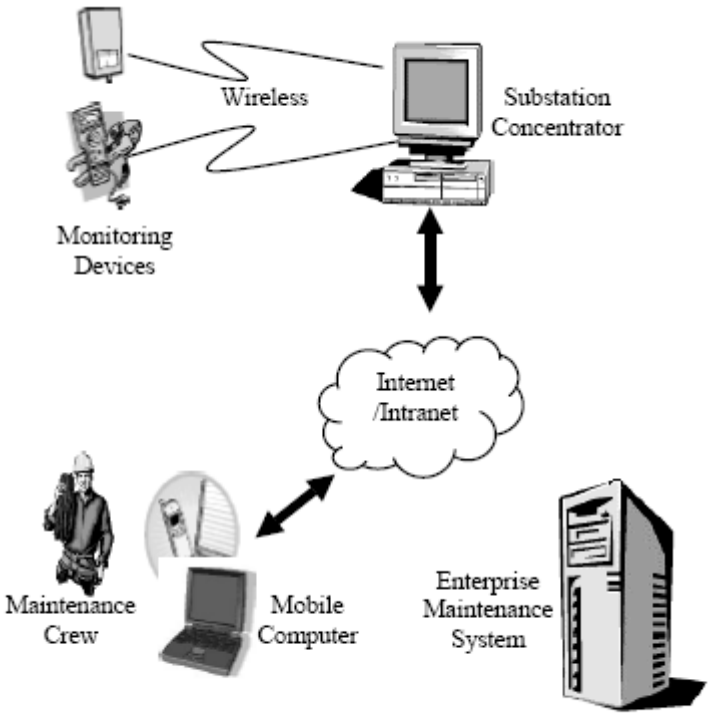

Fig. . Application scenario

Information Storage and Retrieval

The mobile agent can help storing and retrieving all the information needed to perform maintenance or repair work. Mobile agent software supports accessing the data saved into heterogeneous systems. The heterogeneity may be reflected platform wise (differences in protocol, differences in format), concept wise (differences in schema and vocabulary, relative incompleteness), or both. Mobile agent software provides a framework to work in heterogeneous environments. At first, the Java platform is highly portable, which makes the mobile agent server run on a plethora of platforms. Second, the mobile agent server will save the status of mobile agents, therefore providing reliable transmits on slow or part-time connected networks

Circuit Breaker Monitoring

The distributed event mechanism is helpful in monitoring the status and events of circuit breakers. The user can select the event of interest to monitor. Once the monitoring starts, the selected events will be registered with the mobile agent server running on the corresponding substation concentrator. The concentrator can get the real time information about the circuit breakers by communicating with sensors, and it can notify the user when the selected type of event happens.

Security Consideration

Two apparent security problems arise when applying mobile agents. First, the mobile agents need to be authenticated and authorized at the servers. Second, to ensure the integrity of the data, it must be transmitted in secure communication channels. Every mobile agent must be authenticated at first to identify whom it represents. Secure Agent supports user authentication by using the username/password pairs. Once identified, mobile agents can be checked against the security policy to see whether they are authorized to do certain things at a server. The Administrator tool provides a user-friendly interface for the server security and service management. The user interface to assign different types of permissions to users or groups is provided.

Other

Some other applications of agent technique have been proposed. For example, agents can improve the usability of some software by providing a friendly user interface with ability of speech recognition and synthesis

So Mobile agent software may be suitable for applying in circuit breaker maintenance practice due to its support for heterogeneous systems, security, distributed events, low-bandwidth usage, etc. Using the mobile agent software, the development work can be greatly simplified.

Review of Solar Photovoltaic Maximum Power Point Tracking Techniques

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Introduction

PHOTOVOLTAIC power is an established technology and has recently experienced rapid growth over the last twenty years. The maximum power point tracking (MPPT) is the automatic control algorithm to adjust the power interfaces and achieve the greatest possible power harvest, during moment to moment variations of light level, shading, temperature, and photovoltaic module characteristics. It has become an essential component to evaluate the design performance of photovoltaic power systems. In recent years, many publications give various solutions to the problem of maximum power point tracking for photovoltaic power systems. In 2006, the review study has summarized various MPPT techniques and has presented valuable comparisons between them [1-2]. To continue the literal chronology, this paper focuses more on the implementation topology and the latest MPPT techniques with a brief discussion and classification, which can be useful as a reference for future research.

Maximum Power Point Tracking algorithms (MPPT) are used to track maximum power, a DC-DC Boost converter is used to obtain the impedance matching between the PV array and the load. Although a huge number of approaches have been proposed in literature, the methods based on the perturb and observe (P&O) technique are the most widely employed in commercial products. The reason lies in the fact that P&O can be implemented in cheap digital devices by ensuring high robustness and a good MPPT efficiency. This paper aims to presents the design and development of a photovoltaic system based on the enhanced P&O algorithm that allows improving efficiency, stability and accuracy of solar systems. The effectiveness of the proposed solar regulator system is verified by the simulation by Power Sim simulator and experimental results under our developed system using two MPPT algorithms, classical P&O and a new enhanced P&O algorithm.

DC-DC CONVERTER ANALYSIS

DC/DC Converters are most widely applied in photovoltaic systems as an intermediary between the PV and the load to follow up the maximum power point (MPP). Different topologies and different design approaches could be used for DC/DC converters. In this part two different models of converters are introduced, buck and boost converters. The diagrams in Figure.a and Figure.b show the structure of these converters with the switching period T and duty cycle d. For each converter, state space equation of voltage for both buck and boost converters is given in Equation (1) and Equation (2).

A. Buck converter

The buck converter is known as the voltage step down and current step up converter [3]. This gives a hint of its typical application of converting its input voltage into a lower output voltage, where the conversion ratio M = Vout/Vin varies with the duty ratio D of the switch [3],[4]. The state space equation of buck converter is as follows:

$$dI_L/dt = -1/L.Vo + d/L.Vpv \qquad (1)$$

B. Boost converter

The boost converter is also known as the step-up converter. The name implies its typically application of converting a low input-voltage to a high output voltage, essentially functioning like a reversed buck converter [3],[4]. The state space equation of boost converter is as follows:

$$dI_L/dt = -(1-d)/L.Vo + 1/L.Vpv \qquad (2)$$

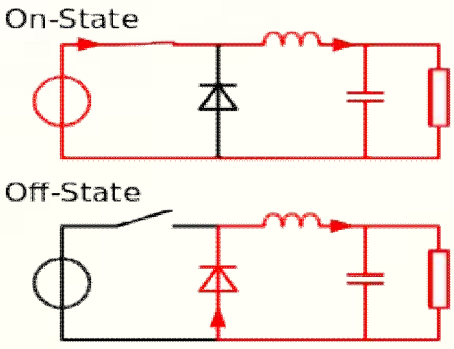


Figure 1a

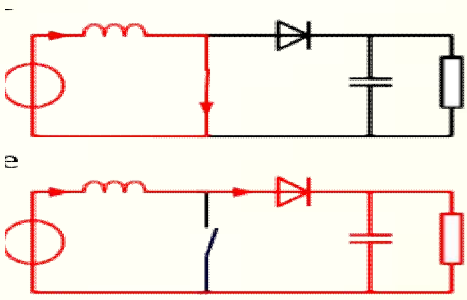


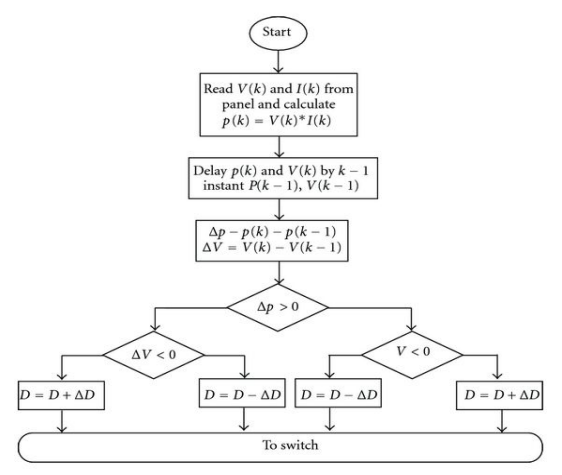
Figure 1b

MPPT TECHNIQUE

As was previously said, MPPT algorithms are necessary in PV applications because the MPP of a solar panel varies with the irradiation and temperature, so the use of MPPT algorithm is required in order to obtain the maximum power from a solar array.

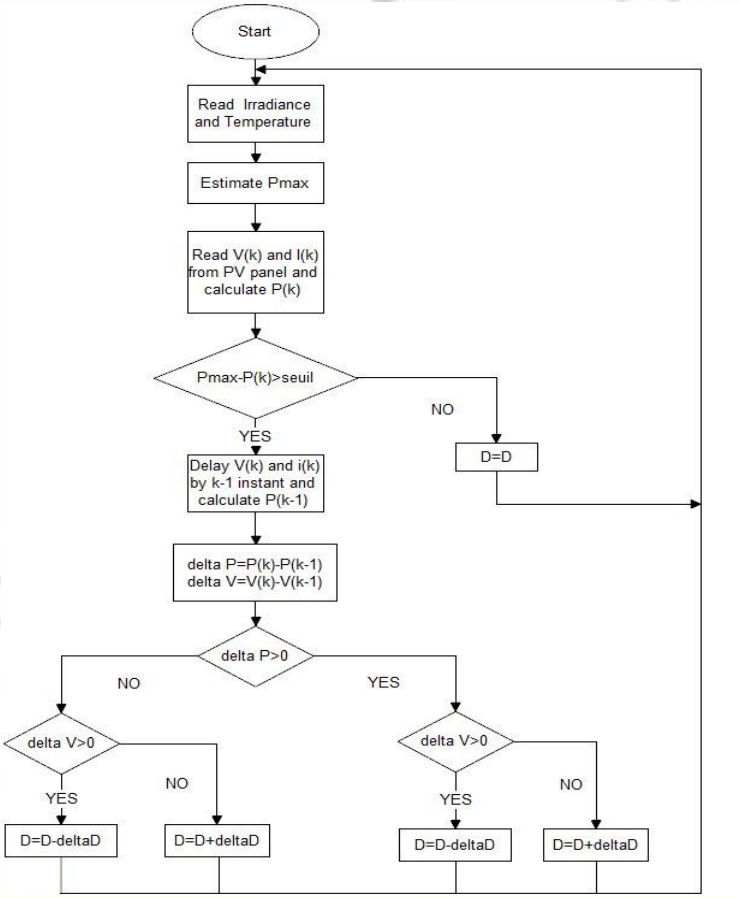
A. P&O Method

The Perturb and Observe (P&O) method is one of the most commonly used methods in practice. The P&O algorithms operate by periodically perturbing, i.e. incrementing or decrementing, the array terminal voltage and comparing the PV output power with that of the previous perturbation cycle. If the PV array operating voltage changes and power increases, the control system moves the PV array operating point in that direction. Otherwise, the operating point is moved in the opposite direction, Figure demonstrates the principle of the P&O algorithm. The DC-DC controller adjusts slightly the voltage from the PV array and measures power, then it varies the terminal voltage of the PV and takes a second measurement of the power, if it increases, further adjustments in that direction are tried until power no longer increases.



B. Enhanced P&O

The P&O algorithm is based on the "hill-climbing" principle, which consists of moving the operation point of the PV array in the direction in which the power increases [6] and [7]. Hill-climbing techniques are the most popular MPPT methods thanks to their ease of implementation and good performance when the irradiation is constant [7]. The advantages of P&O method are the simplicity and low computational power they need. The drawbacks of this technique are mainly two; the main one is that they can easily lose track of the MPP if the irradiation changes rapidly [7], [9], [10]. The other handicap of P&O method is the oscillations of the voltage and current around the MPP in the steady state [9], [11], [12] and [13]. To overcome these drawbacks, we propose a new enhanced P&O.



In this technique, the Maximum Power is calculated based on the measurements of the Irradiance and the Temperature using a model of the PV module. After calculating the max power, we run the classical P&O algorithm and after each complete execution cycle the difference between the current power (real power) and the power estimated at the beginning of the algorithm is calculated. If the difference is zero, then we have reached the max power, so the present duty cycle value is the optimal control signal. This value is fixed and is taken as control signal for DC- DC boost converter until the next variation of the maximum power that PV can provide. The efficiency of the classical P&O algorithm tracking is improved by the new enhanced algorithm. This technique was simulated in power Sim, implemented and tested using a complete system based on a microcontroller, a DC-DC boost converter, a voltage and current sensors and a software application.

C. Incremental conductance method

This method uses two sensors for sensing voltage and current. The controller measures the incremental changes in the voltage and current, hence conductance of the array and predicts the effect of voltage

change. Controller compares the changes in the incremental conductance and array conductance [16-17]; when these two are same the array voltage is MPP voltage. The drawback of this method is that it loses track of MPP due to changes in the irradiation level.

D. Fractional open circuit voltage method (FOCV)

The value of V_{mpp} is almost equal to Voc under changing irradiance and temperature conditions, so it becomes easy to track MPP [18]. V_{mpp} of a solar cell is given by equation (3),

$$V_{mpp} = K\, V_{oc} \qquad (3)$$

The value of K lies between 0.71 to 0.78, and using the value of K and V_{oc}, V_{mpp} can be easily determined.

E. Fractional short circuit current method (FSCI)

In this method the FOCV method is considered in terms of current. Here, short circuit current and current at MPP are related [18]. The relation is given by equation (4),

$$I_{mpp} = K I_{sc} \qquad (4)$$

It is difficult to measure I_{sc} during operation, so an additional switch is added to the converter to short PV array periodically and measure I_{sc}.

F. Fuzzy logic control

Fuzzy logic control is a soft computing tool. This method consists of three stages: Fuzzification, rule base table and de-fuzzification [19-24]. The advantage of this method is that it can work with imprecise and vague inputs and is able to handle non- linearity.

CONCLUSION

In this paper the increasing demand for renewable resources of energy has been emphasized. Mathematical model for PV cell is explained and the need for MPPT to achieve maximum power output is presented with the help of diagram. This paper provides classification of various MPPT techniques, their advantages and disadvantages. An enhanced P&O algorithm has been proposed so as to improve the maximum power point tracking in PV systems. The proposed system offers powerful abilities which are: good tracking efficiency, high response, simple user interface, sophisticated control, high processing speed, real time monitoring and good control for the extracted power. This paper will serve as a reference paper for the future work in PV power generation.

STUDENTS' CORNER

PLC handbook- A practical guide to Programmable logic controller

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Introduction:-

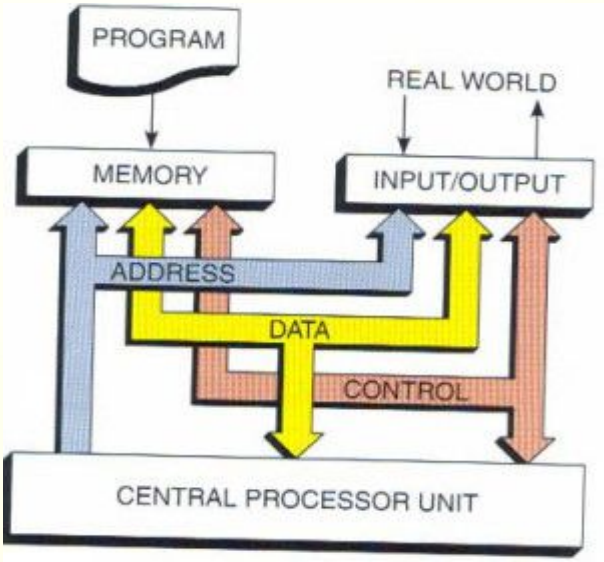
Programmable Logic Controller (PLC) is a special computer device used in industrial control systems. Due to its robust construction, exceptional functional features like sequential control, counters and timers, ease of programming, reliable controlling capabilities and ease of hardware usage – this PLC is used as more than a special-purpose digital computer in industries as well as in other control-system areas. Most of the industries abbreviate these devices as "PC" but it is also used for personal computers; due to this, many manufacturers named these devices as PLCs.

The programmable logic controller is used not only for industrial purpose but also in civil applications such as washing machine, elevators working and traffic signals control. Different types of PLCs from a vast number of manufacturers are available in today's market. Therefore, in the following paragraphs, let us study about programmable logic controller's basics, principles and applications.

Principle of Programmable Logic Controller:

A programmable logic controller is used for continuously monitoring the input values from sensors and produces the outputs for the operation of actuators based on the program. Every PLC system comprises these three modules:

- CPU module
- Power supply module
- One or more I/O module



PLC Architecture

CPU Module:

A CPU module consists of central processor and its memory. The processor is responsible for performing all the necessary computations and processing of data by accepting the inputs and producing the appropriate outputs.

Power Supply Module:

This module supplies the required power to the whole system by converting the available AC power to DC power required for the CPU and I/O modules. The 5V DC output drives the computer circuitry.

I/O Modules:

The input and out modules of the programmable logic controller are used to connect the sensors and actuators to the system to sense the various parameters such as temperature, pressure and flow, etc. These I/O modules are of two types: digital or analog.

Communication Interface Modules: These are intelligent I/O modules which transfers the information between a CPU and communication network These communication modules are used for communicating with other PLC's and computers, which are placed at remote place or far-off locate.

The program in the CPU of programmable logic controller consists of operating system and user programs. The purpose of the operating system with CPU is to deal with the tasks and operations of the PLC such as starting and stopping operations, storage area and communication management, etc. A user program is used by the user for finishing and controlling the tasks in automation.

The Principle of operation of the PLC can be understood with the cyclic scanning also called as scan cycle, which is given in the below figure.

Applications of Programmable Logic Controller (PLC)

The PLC can be used in industrial departments of all the developed countries in industries like chemical industry, automobile industry, steel industry and electricity industry. Based on the development of all these technologies, functionality and application, the scope of the PLC increases dramatically.

1. Application of PLC in Glass Industry

From the year 1980 the Programmable-logic controllers are in use in the glass industry, and they are assembled bit by bit. PLCs are used mainly in every procedure and workshop for controlling the material ratio, processing of flat glasses, etc.

With the development of PLC and increasing demand in the real world, the control mode of the programmable-logic controller with an intelligent device is applied in the glass industry. In making of a float glass, PLC itself cannot finish some controlling tasks because of the complexity of the control system and processing of huge data. For the production of glass, we make use of bus technology to

construct the control mode of a PLC with a distributed-control system. This control system deals with analog controlling and data recording; the PLC is also used for digital quality control and position control.

This type of control mode is a big advantage for PLC and DCS for improving reliability and flexibility of the control system.

2. Applications of PLC in Cement Industry

Along with the best-quality raw materials, the accurate data regarding process variables, especially during mixing processes within the kiln, ensures that the output provided should be of the best possible quality. Nowadays a DCS with bus technology is used in the production and management industry. By using this existing DCS control system, the PLC is in user mode of SCADA. This mode comprises PLC and configuration software. This SCADA mode comprises the PLC and host computer. The host computer consists of slave and master station. The PLC is used for controlling the ball milling, shaft kiln and Kiln of coal.

Thus, this article has covered the principle of operation of programmable logic devices or controller and its applications in various industries like glass industry, steel industry and cement industry.

Harmonics in Power System and How It Can be Reduced

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Harmonics are electric voltages and currents on an electric power system that can cause power quality problems. Harmonics are created by electronic equipment with nonlinear loads drawing in current in abrupt short pulses. The short pulses cause distorted current waveforms, which in turn cause harmonic currents to flow back into other parts of the power system.

Problems Caused By Harmonics:-

1. Overloading neutral conductor

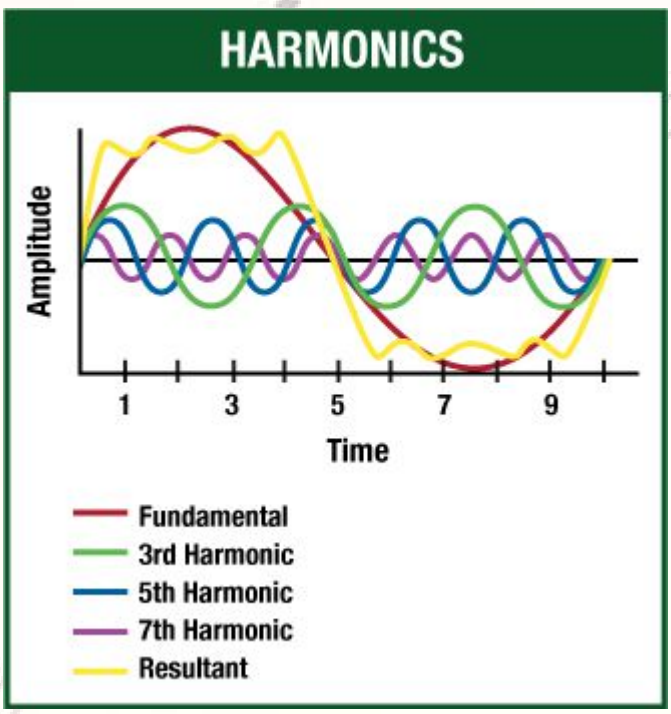
The three-phase system consists of three individual phase conductors and a neutral conductor. If all the phase conductors carry the same current, the phase currents tend to cancel one another out provided there is a balanced load. This balanced load makes it possible to reduce the size of the neutral conductor. Unfortunately, switched mode power supplies used in computers have a very high third-harmonic current. While harmonic currents cancel out on the neutral wire, the third harmonic current is additive in the neutral. In buildings with a large number of installed personal computers, the neutral wire can carry much higher currents than the wire was designed to accommodate, creating a potential fire hazard.

2. Overheating Transformers and Increased Associated Losses

For transformers feeding harmonic-producing loads, the eddy current loss in the windings is the most dominant loss component in the transformer. This eddy current loss increases proportionate to the square of the product's harmonic current and its corresponding frequency. The total transformer loss to a fully loaded transformer supplying to a nonlinear load is twice as high as for an equivalent linear load. This causes excessive transformer heating and degrades the insulation materials in the transformer, which eventually leads to transformer failure.

3. Nuisance Tripping of Circuit Breakers

All circuits containing capacitance and inductance have one or more resonant frequencies. When any of the resonant frequencies correspond to the harmonic frequency produced by nonlinear loads, harmonic resonance can occur. Voltage and current during resonant frequency can be highly distorted. This distortion can cause nuisance tripping in an electrical power system, which can ultimately result in production losses.



HOW THE HARMONICS CAN BE REDUCED:-

1. Reducing harmonic currents in loads

There is often little that can be done with existing load equipment to significantly reduce the amount of harmonic current it is producing unless it is being mis-operated.An overexcited **transformer** can be brought back into normal operation by lowering the applied voltage to the correct range, arcing devices and most electronic power converters are locked into their designed characteristics.

PWM drives that charge the dc bus capacitor directly from the line without any intentional impedance are one exception to this. Adding a line reactor or transformer in series will significantly reduce harmonics, as well as provide transient protection benefits.

2. Filtering

The shunt filter works by short circuiting harmonic currents as close to the source of distortion as practical. This keeps the currents out of the supply system. This is the most common type of filtering applied because of economics and because it also tends to correct the load power factor as well as remove the harmonic current.

3. Modifying the system frequency response

There are number of methods to modify the frequency response of the system:-

- **Add a reactor to detune the system**. Harmful resonances generally occur between the system inductance and shunt power factor correction capacitors. The reactor must be added between the capacitor and the supply system source. One method is to simply put a reactor in series with the capacitor to move the system resonance without actually tuning the capacitor to create a filter. Another is to add reactance in the line.
- **Change the capacitor size**. This is often one of the least expensive options for both utilities and industrial customers.
- **Move a capacitor** to a point on the system with a different short-circuit impedance or higher losses. This is also an option for utilities when a new bank causes telephone interference—moving

the bank to another branch of the feeder may very well resolve the problem. This is frequently not an option for industrial users because the capacitor cannot be moved far enough to make a difference.

- **Remove the capacitor** and simply accept the higher losses, lower voltage, and power factor penalty. If technically feasible, this is occasionally the best economic choice.

By using these methods we can eliminate harmonics in a proper manner.

Robo Pets

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Pets are often lovable companions that bring joy to their respective owners. However, one of the inconveniences of pet ownership is the constant support that pets require as most are not self-sufficient. For those seeking a pet companion but not the responsibilities a robotic pet may be a option. While the major benefit of a live pet is the unwavering companionship, robotic pets have nice benefits in their own right.

Fewer Responsibilities

Unlike a real pet, there is no need to continually refill the water and food bowls. Better yet, there are no sad, puppy-dog eyes seeking food off the dinner table.
As there is no need to feed the robotic pet, there is also no dealing with any after-dinner walks. And there's the benefit of a home free of the odours associated with those bodily functions. Live animals, especially dogs, get dirty, can smell, and need a bath. However, with a robotic pet, none of that is required.

Robotic Pets won't be a "Bad" Pet

Real pets, especially those that are not trained, may chew on or damage furniture or other property. Animals may also bite those who feed, pet, or attempt to play with them. A live pet may make unwanted or excessive noises, such as loud barking from a dog or continuous chirping from a bird. (Time to call a trainer)On the other hand, a robotic pet's actions are always controllable.

Less in the Long Run

The price of a robotic pet will vary and the same is true for the price of a live pet as it would apply to the pet's breed, heritage, and consumer market. However, robotic pets will cost less in the long run as the majority of the expenses will be absorbed in the initial purchase, given that only batteries or electricity for recharging will need to be purchased in the future. The cost of a live pet becomes more expensive over time as an owner will continually have to purchase food, toys, and health care.

Robotic Pets Are Convenient

Some studies have shown that robotic pets are just as beneficial in preventing loneliness particularly among the senior population. Robotic-pet owners have full control over their pet and can initiate attention and playtime because a robotic pet can be turned off. The absence of support required when an owner leaves the home or goes on vacation is another consideration.

Robotic Pets Do Things Live Pets Can't

Robots are programmed to perform certain functions, such as to communicate with the owner. Some highly-advanced robotic pets can be trained by the owner. If the owner prefers a pet that has the

excitement of a new puppy, that's a behavioral option for the robotic pet allowing an owner to indefinitely have a puppy.

Robotic pets will vary in technological capabilities, but robotic pets will only get better as technology continues to advance. A simple robotic pet may be stationary and have limited actions, typically facial movements such as closing and opening the eyes and mouth. Other robots may be available that are mobile, including the ability to follow an owner around, or that have more intricate features such as recognizing voice commands. While robotic pets may not fulfill the real-life aspect desired by some, the pets certainly do have their own advantages. Some of the benefits are directly the opposite of the negatives associated with a live pet, which will greatly appeal to some prospective owners. It will ultimately be a personal choice, but don't forget: Having one doesn't mean not having the other. Owning both is always a possibility, and an owner's live pet will possibly enjoy playing with the robotic pet too.

CONCLUSION

At last we can see that a robotic pet can also speak, where as only few birds can accomplish that feat; but who wants to carry on a conversion with their cat.

A robotic dog won't bite or scratch you. robotic pet technology will soon be sophisticated enough to cover our emotional needs robotic dogs, for instance , will have social intelligence, providing what people need from their dogs, such as companionship, love, obedience, dependence etc. just because you have a robotic pet doesn't mean that you couldn't also have a live pet as well. Possessing both is always a prospect benefit from playing with the robotic pet as well

Eddy Current Brake

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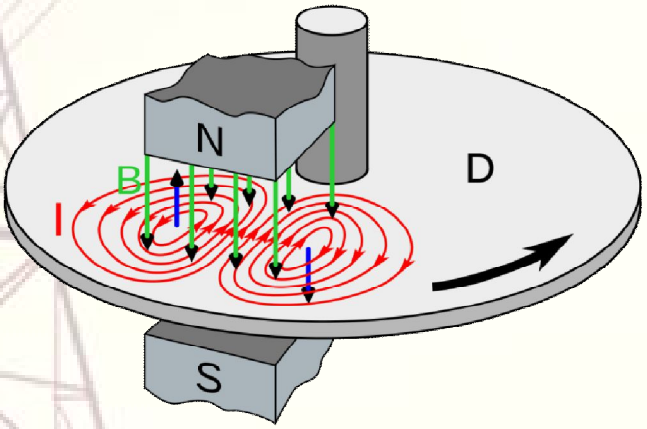
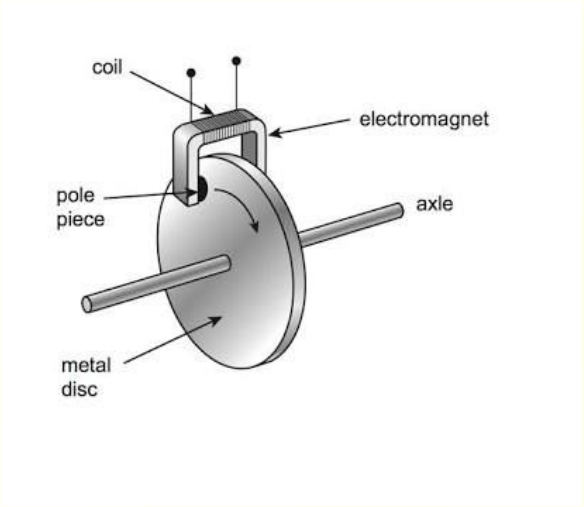
Need For It:-

Many of the ordinary brakes, which are being used now a day's to stop the vehicle by means of mechanical blocking. This causes skidding and wears & tears of the vehicle and if speed of the vehicle is very high, the brake can't provide that much high braking force & it will cause problem .These drawbacks of ordinary brakes can be overcome by "The Eddy current brake".

Principle Of Operations :- (It works according to Faraday's law of electromagnetic induction)

Essentially the Eddy current brake consists of two parts, a stationary magnetic field system and a solid rotating part, which include a metal disc. During braking the metal disc is exposed to a magnetic field from an electromagnet, generating Eddy currents in the disc. The magnet interaction between the applied field and the Eddy currents slow down the rotating disc. Thus the wheels of the vehicle also slow down since the wheels are directly coupled to the disc of the Eddy current brake, thus producing smooth stopping motion.





TYPES:-

It is of two types

1- Electrically excited eddy current brake
2- Permanent magnetic eddy current brake

Electrically excited eddy current brake:-

Electrically excited eddy current brakes are abruption-free method for braking. In high-speed trains they offer a good alternative to the mechanical rail brakes which are being used now a-days. During braking,

the brake comes in contact with the rail, and the magnetic poles of brakes are energized by a winding supplied. Magnetic poles of brakes are energized by a winding supplied with current from the battery. Then the magnetic flux is distributed over the rail. The eddy currents are generated in the rail, producing an electromagnetic braking force. These types of braking need an additional safety power supply when there are breakdowns in the electrical power supply.

The maximum diameter of the Eddy current brake is decided by

1- The spacing of vehicle chassis frame

2- Vehicle floor clearance

In this breaking system kinetic energy of the vehicle is converted to heat and this heat is dissipated through the rotating disc.

WORKING:-

When the vehicle is moving, the rotor disc of eddy current brake which is coupled to the wheels of the vehicle rotates, in close proximity to stationary magnetic poles. When we want to brake the vehicle, a control switch is put on which is placed on the steering column in a position for easy operation.

When the control switch is operated, current flows from a battery to the field winding, thus energizing the magnet. Then the rotating disc will cut the magnetic field. When the disc cuts the magnetic field, flux changes occur in the disc which is proportional to the strength of the magnetic field. The current will flow back to the zero field areas of the metal plate and thus create a closed current loop like a whirl or eddy. A flow of current always means there is a magnetic field as well. Due to Lenz's law, the magnetic field produced by the eddy currents works against the movement direction. Thus instead of mechanical friction, a magnetic friction is created. In consequence, the disc will experience a "drag" or the braking effect, and thus the disc stops rotation. The wheels of the vehicle, which is directly coupled to the disc, also stop rotation. Faster the wheels are spinning, stronger the effect, meaning that as the vehicle slows, the braking force is reduced producing a smooth stopping action.

The control switch can be set at different positions for controlling the excitation current to several set values in order to regulate the magnetic flux and consequently the magnitude of braking force. i.e. if the speed of the vehicle is low, a low braking force is required to stop the vehicle. So the control switch is set at the lowest position so that a low current will be supplied to the field winding. Then the magnetic field produced will be of low strength, so that a required low braking force is produced.

When the control switch is operated during the standby position of the vehicle, the magnet will be energized and magnetic field is created. But since the wheels are not moving, magnetic lines of force are not cut by it, and the brake will not work. However, a warning lamp is provided on the instrument panel

to indicate whether the brake is energized. This provides a safe guard for the driver against leaving the unit energized.

When control switch is put in any one of the operating positions, the corresponding conductor in the contractor box is energized and current flows from the battery to the field winding to the contractor box. This current magnetizes the poles in stator, which placed very near to the rotor. When rotor rotates it will cut magnetic lines and eddy current will set up in the rotor. The magnetic field of this eddy current produces a braking force or torque in the opposite direction of rotation disc. This kinetic energy of rotor is converted as heat energy and dissipated from rotating disc to surrounding atmosphere. Current in the field can change by changing the position of the controls switch. Thus we can change the strength of the braking force.

APPLICATION:-

In case of TRAINS, the part in which the current is induced is rail. Brake shoe is enclosed in a coil from an electromagnet, when the magnet is energized, Eddy current are induced in the rail by means of an electromagnetic induction probably producing braking action.

Power Losses in Distribution Lines: How to Reduce Them?

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The electrical transmission and distribution losses accounts for most of the power losses in the entire system.
The largest amounts of these losses occur in the primary and secondary distribution lines, and can be classified as either technical losses or non technical losses.

- Technical electrical power losses:

Technical losses occur when the energy is dissipated by the equipment and conductors in the distribution lines. The losses depend on the network characteristics, and mode of operation. There are two categories of technical power losses; the fixed technical losses and the variable technical losses.

- Fixed technical losses:

The fixed losses in the distribution lines account for between a quarter and a third of the total technical losses. These are usually in the form of heat and noise and occur whenever the transformer is energized.

The fixed losses are not influenced by the amount of load current flowing, but rather by

- The leakage current losses
- Open circuit losses
- Corona losses
- Dielectric losses

- Variable technical losses:

The variable losses are proportional to the square of the load current and accounts to between 2/3 and ¾ of the technical losses in a distribution system.

The variable losses arise due to the line impedance, contact resistance and the joule heating losses.

- Causes of technical losses:

- Inefficient equipment such as the transformers, pumps, electrical machines and industrial loads.
- Inadequate size of conductor in the distribution lines
- Long distribution lines
- Load imbalance among the phases
- Low power factor.
- Over loading of lines
- Transformers installed far from the load centers
- Haphazard installation of distribution systems to cope with demands to new areas
- Bad workmanship

❖ Commercial (non-technical) power losses:

The non-technical losses, also referred to as commercial losses, are those related to unmetered supplies, incorrect billing, untimely billing, wrong tariff, defective meters and energy thefts.
The unmetered supplies are those that may be left out when estimated amounts are used to calculate the amount of power to bill for. In addition, some consumers may tamper with the meters to make them indicate less power than what is actually used.
The energy theft may occur when consumers tamper with the metering, or collude with the utility personnel to make illegal connections.

❖ Analysis of loss reduction initiatives :

Following analysis are performed on the various loss reduction initiatives –

1. Type 1 Analysis – Overall Analysis of Loss Reduction initiatives included, classifying initiatives in 4 broad categories based on the number of states adopted for the same.
2. Type 2 Analysis – State Specific analysis included analysis to map types of initiatives against type of losses they are effective in reducing.

❖ Type 1 Analysis – Overall Analysis of Loss Reduction:

Depending on the number of states has adopted a particular initiative, an analysis has been done and initiatives are classified into four categories:

- Must have Initiatives: Initiatives adopted by 8 or more utilities out of 10 selected utilities.
- Strongly desirable initiatives: Initiatives adopted by 5 to 7 utilities out of 10 selected utilities.
- Good to have initiatives: Initiatives adopted by 3-4 utilities out of 10 selected utilities.
- Other initiatives: Initiatives adopted by 2 or less no. of utilities out of 10 selected utilities.

❖ Type 2 Analysis - State Specific analysis:

Further, we have analyzed various loss reduction initiatives to identify the best initiatives which can have maximum impact for each type of loss and for each type of consumer category. In order to do so, a framework has been developed in discussion with the FOR secretariat, which identifies a particular state as an ideal case study for tackling a particular type of loss. Depending on this analysis, the following table signifies such states.

❖ Development of loss reduction strategy:

To develop a loss reduction strategy, the following framework can be adopted -

- Define 'as-is' loss situation and desired 'to-be' state–
  The Discoms should define a detailed loss reduction trajectory for each type of loss, along with the current levels of losses for the utility.
- Measurement of loss - Various types of losses can be measured as follows:

➢ Technical Loss = Energy input in the Discom periphery – Energy Consumed in the Distribution
➢ Network, or Technical Loss = [Energy input at the discom periphery – (DT level consumption+ sum of sales to consumer on HT)] + LT technical loss
➢ Non-Technical Loss (occurring due to incorrect energy accounting) = Energy Consumed in the Distribution Network – Energy billed to consumers, or Non-technical loss (occurring due to incorrect energy accounting) = Energy input in the Discom periphery – (technical loss + energy sales)

➢ Non-Technical Loss (occurring due to non-recovery) = Energy billed to consumers – Energy collected from consumers, or Non-technical loss (occurring due to non-recovery) = 100% - [billing efficiency (%)*collection Efficiency (%)] Where billing efficiency=100-distribution losses (%).

❖ How to reduce power losses in distribution lines?

Losses in the distribution of electricity cannot be eliminated, but can be minimized by proper planning of the distribution systems to ensure that power remain within limits. Some of the ways to reduce losses include;

- Use of proper jointing techniques, and keeping the number of the joints to a minimum.
- Regular inspection of the connections, isolators, drop out fuses, LT switches, transformers, transformer bushing-stem, and other distribution equipment.
- Proper selection of conductor size, as well as the transformer in terms of efficiency, size and location. In particular, it is important to locate the distribution transformers at the load centre and if possible keep the number to a minimum.
- Feeding heavy consumers directly from the feeders.
- Maintain the network components and replace those that are deteriorating, worn out or faulty.
- Proper load management and load balancing
- Use of electronic meters which are accurate and tamper-proof.
- Improving power factor by adding shunt capacitors.

Summary:
Power losses in an electrical distribution network can be minimized by proper planning and designing of the lines, use of efficient equipment at both the distribution and consumer levels. In addition, there should be periodic maintenance, and replacing of malfunctioning and energy inefficient distribution equipment and parts.

Smart Card

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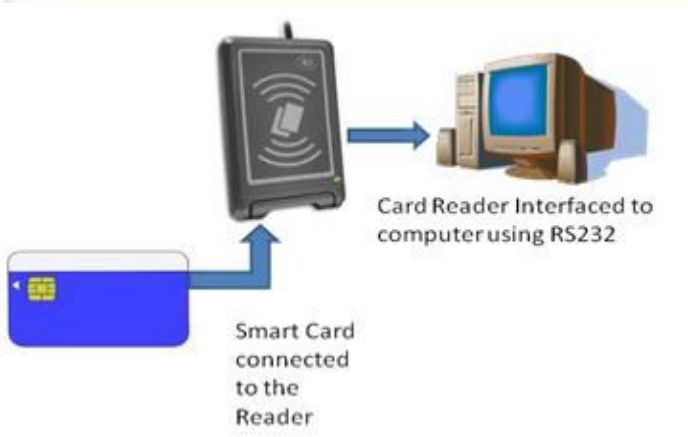
What is a Smart Card?

A smart card is a special type of card like device which contains an integrated circuit chip embedded on it. The IC chip can be a microprocessor with memory or just simple memory circuit. In simple layman's words, a smart card is the card with which we can exchange the data, store it and manipulate data.

How does the Smart Card Works?

A smart card is connected to the host computer or controller via a card reader which gets information from the smart card and accordingly passes the information to the host computer or controller.



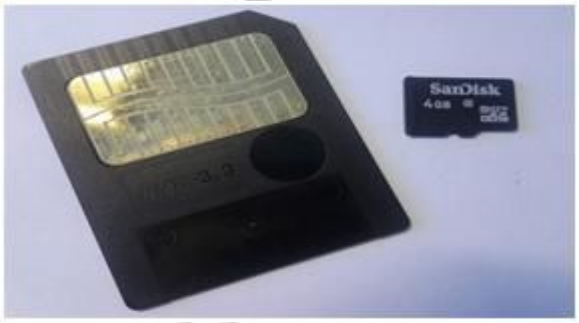
A **Basic Smart Card Working System**

What is a Smart Card Reader?

A smart card reader is a device to which the smart card is connected either directly or indirectly using RF communication. It interfaces with the PC or a microcontroller using USB port or RS232 serial ports. It can be a contact or contactless reader.


A Contactless Smart Card System

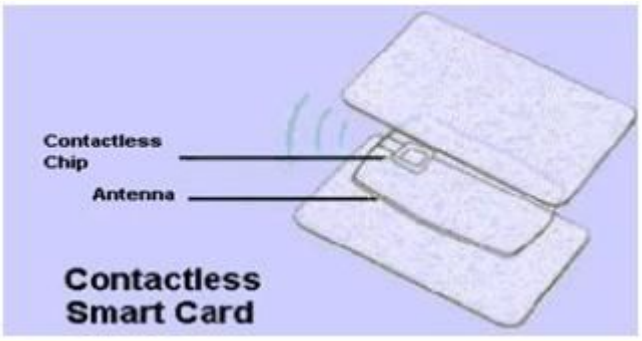

A Contact Smart Card System



Smart Card Reader:-

Types of Smart Card based on Connection to the Smart Card Reader

- **Contact Smart Card**: This type of smart card consists of electrical contacts which are used to connect to the card reader where the card is inserted. The electrical contacts are deployed on a conductive gold plated coating on the card surface. A Contact Smart Card with Electrical Connections
- **Contactless Smart Card**: This type of smart card communicates with the reader without any physical contact. Rather it consists of an antenna with which it is used to communicate using Radio Frequency band with the antenna on the reader. It usually receives power from the reader via the electromagnetic signal.



A Contactless Smart Card

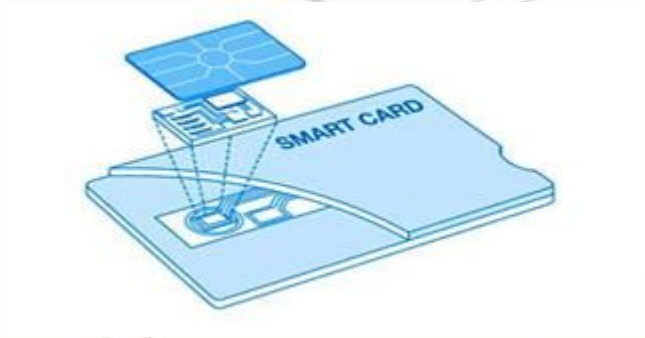
2 Types of Smart Cards based on their Functionalities and Configuration

- **Memory Cards:** These are cards which only consist of memory circuits. It can only store, read and write data to a particular location. The data cannot be processed or manipulated. It can be a straight memory card which is only used to store data or a protected memory card with a restricted access to the memory and which can be used to write data. It can also be a rechargeable or a disposable card which contains memory units which can be used only once.
-

A Memory Smart Card

- **Microprocessor Based Cards:** These cards consist of microprocessor embedded onto the chip in addition to the memory blocks. It also consists of specific sections of files with each file associated with a particular function. The data in files and the memory allocation is managed via an operating

system which can be a fixed operating system or dynamic operating system. It allows for data processing and manipulations and can be used for multi-functioning.



Microprocessor Based Smart Card

4 Steps to Construct a Smart Card

- The first step involves **designing**. The designing involves specifying the chip for the memory size, clock speed, volatile memory types, type of operating system and specifying the application software, specifying the card type, size and functioning and additional features.
- The second step involves **chip fabrication**. This involves mounting the silicon chip on an epoxy glass substrate with gold plated connectors, using a die. The silicon chip is bonded to the connectors using connecting wires (wire bonding technique) or using flip chip technology (using a solder). The chip on board substrate is then sealed using epoxy resin and glued to the card substrate. The card substrate can be PVC based plastic card or Polyester based card.
- The third step involves **loading the code** to the memory using special commands.
- The fourth step involves **data loading** into the PROM memory such that the data pertains to the single person.

Advantages of Smart Card:

- Might be promptly reconfigured
- Reusable
- Secure transactions
- Gives more security
- More tough and dependable
- Permit numerous provisions to be saved in one card

5 Areas of Smart Card Applications:-

- **Telecommunications:** The most prominent use of smart card technology is in the development of **SIM card or Subscriber Identity Module**. A SIM card provides unique identification to each subscriber and provides network access to each subscriber and manages its authentication.

A SIM Card

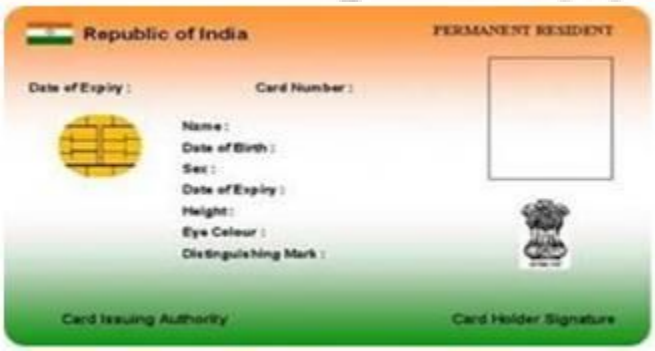
- **Domestic:** The most frequently used smart card in domestic field is the DTH smart card. This card provides authorized access to the information coming from the satellites. In simple words the card with which we can get access to the Direct to Home TV services is nothing but a smart card. The information is encrypted and decrypted within a smart card.

A basic DTH System with the Smart Card

- **Ecommerce and Retail**: Smart card can be used to store information like a person's account details, the transaction details and can be used in purchasing goods online by acting as a credit card. Some retailers can also use smart cards to store points for a particular customer and provide necessary incentives to repeated customers.
- **Banking Application:** The most prominent use of smart card in banking application is the replacement of the traditional magnetic stripe based credit or debit card. An example is the MasterCard and VISA.

VISA Smart Card

- **Government Applications:** Smart cards are being used by Government to issue identity cards to individual, which contains all the details of the individual. An example is the recently started Adhar card scheme in India.



Aadhaar Card Model

Impact of Electrical Engineering in Digitalization

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Today's world is world of high technology starting from most complex rocket science including AI robots.The technical world is dominating the human. Our country India which is developing country is digitalization in the Sector of electrical machinery, electronic manufacturing, high speed internet, broadband highway etc.

The electrification of Indian rail network was increasing day by day and In future we have high speed bullet train which get more electricity to run in high speed,

The electrification of airports in India was also increasing day by day and in future we have more airports To run this airports in future we want more electricity,

In India the vehicles are increasing day by day which need more petrol or diesel to run but in future we don't have more petrol or diesel to run. To short out this problem In future we have another good technology that is ELECTRIC CAR which needs electricity to run,

In future we have ROBOTS and there also we need electricity and In India the quantity of homes, buildings, and hospitals, super markets etc are increasing where we need more electricity. In this all field the hand of "ELECTRICAL ENGINEERING" is INVALUABLE.

Electrical Engineering is the main force behind the digital India, make in India and the power ministry focus on three things one is the village electrification, second one is household electrification and umbrella program for 24×7 power supply. For the continuous supply of power to the smart cities, rails networks, airports, etc. is very essential to have strong and smart transmission and distribution systems.

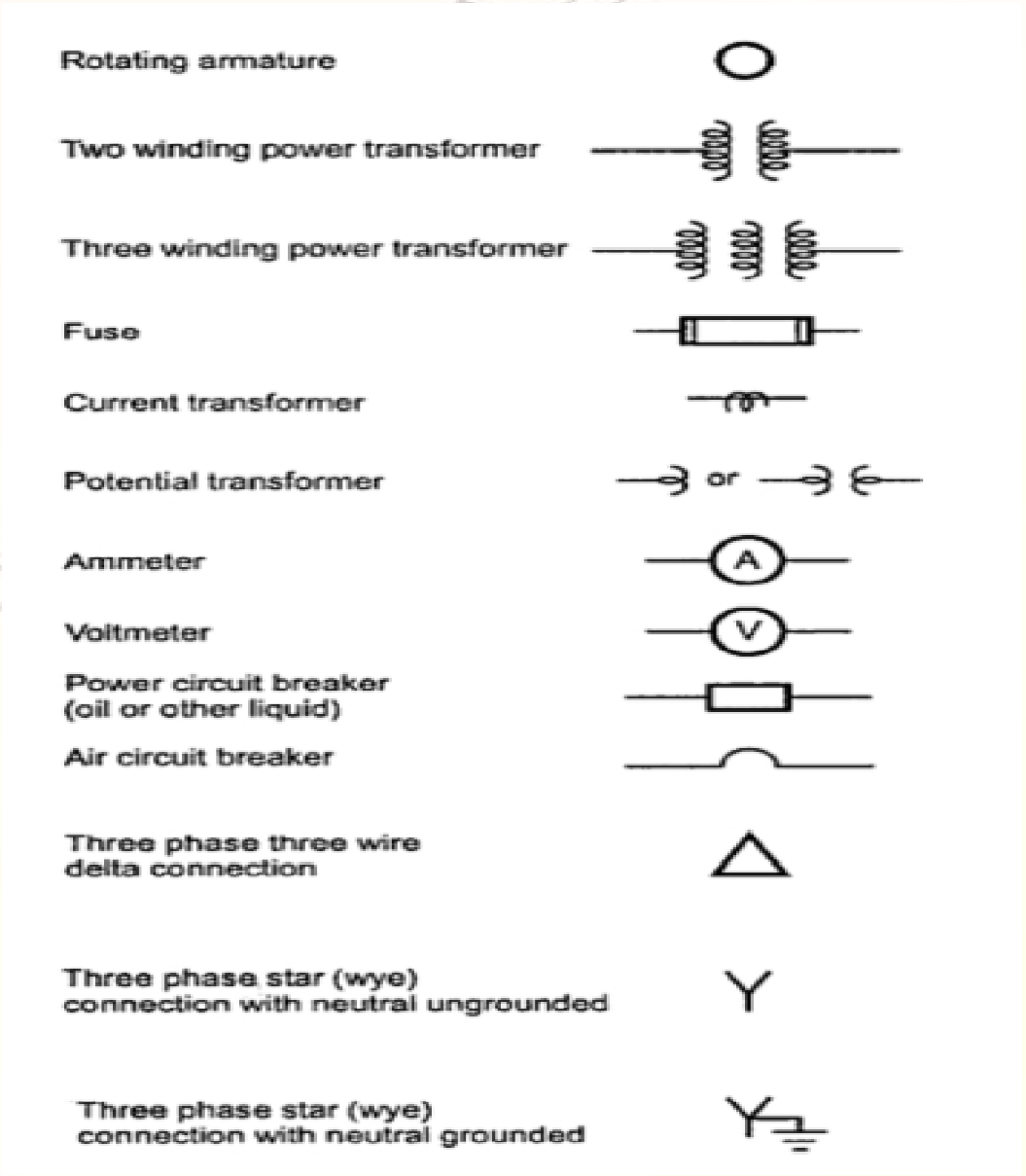
The electrical machinery industry contributes massively to the capital goods sector of India and the electrical machinery industry holds about 69% share in the capital goods industry.

The Indian government has started "MAKE IN INDIA" plan and it is a way ahead. MAKE IN INDIA was launched in 25 September 2014 with objective of job creation, skill enhancement and transform India into global design and manufacturing hub.

Now India is the 4th largest wind power capacity in the world and its capacity stands at 34 GW,
6th largest solar power capacity in the world and its capacity stands at 22 GW and
7th largest producer of hydroelectric power in the world and its capacity at 44,594 MW
Biomass power is the installed in India which produces 8.1 GW power as in November 2017.
The total power generation in India is 70 GW in 2017-2018.
The Indian government has set target of adding 175 GW power in the country by 2022!!
After the surveying of all this above information we found that In future ELECTRICAL ENGINEERING is much more helpful for MAKE IN INDIA AND DIGITAL INDIA POGRAM.

Our Sincere thanks to all the authors & faculties involved in publishing the magazine

SYMBOLS USED IN ELECTRICAL ENGINEERING



SIMPLE VIEW OF POWER SYSTEM