BEES Magazine

August 2021

K S R Institute for Engineering and Technology

Department of Electrical and Electronics Engineering

BEES Magazine

Together We Make Difference

August 2021

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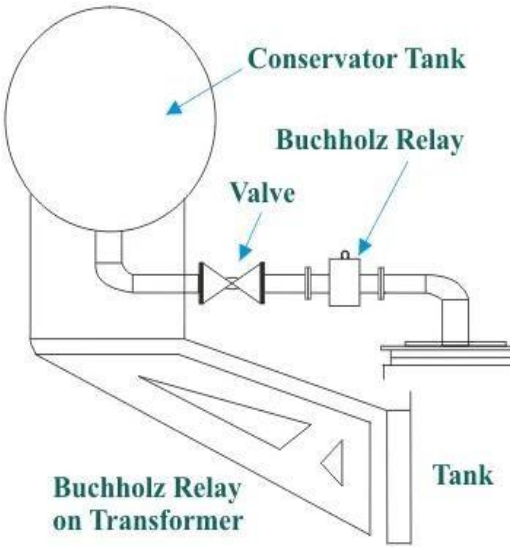
BUCHHOLZ RELAY – AN INDUSTRIAL VIEW

MYTHREYAN J *BHARANIDHARAN C*

Introduction

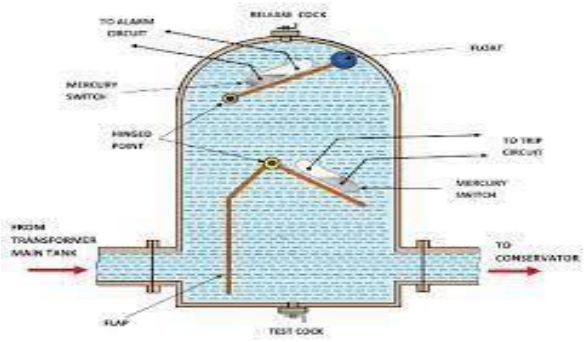
A Buchholz relay is a safety device mounted on (some) oil-filled Power transformer and reactors, equipped with an external overhead oil reservoir called a "conservator". Buchholz relays are used as a protective device, as they are sensitive to the effects of dielectric failure that can occur inside the equipment they protect. Buchholz relays are a type of gas detection relay Buchholz relays have two main elements. The upper element consists of a float. The float is attached to a hinge in such a way that it can move up and down depending upon the oil level in the Buchholz relay container. A mercury switch is fixed on the float. The alignment of the mercury switch hence depends upon the position of the float



The lower element consists of a baffle plate and a mercury switch. This plate is fitted on a hinge just in front of the inlet (main tank side) of the Buchholz relay in a transformer in such a way that when oil enters in the relay from that inlet in high pressure the alignment of the baffle plate along with the mercury switch attached to it, will change.

Buchholz Relay Working Principle

The Buchholz relay working principle is very simple. Buchholz relay function is based on a very simple mechanical phenomenon.



It is mechanically actuated. Whenever there will be a minor internal fault in the transformer such as an insulation fault between turns, break down of core of the transformer, core heating, the insulating transformer oil will be decomposed in different hydrocarbon gases, CO2 and CO. The gases produced. Buchholz relay operation and recommends actions following the receipt of a Buchholz surge trip or gas collection alarm. It

covers both operational situations and situations Due to the decomposition of transformer insulating oil will accumulate in the upper part of the Buchholz container which causes a fall of the oil level in it.

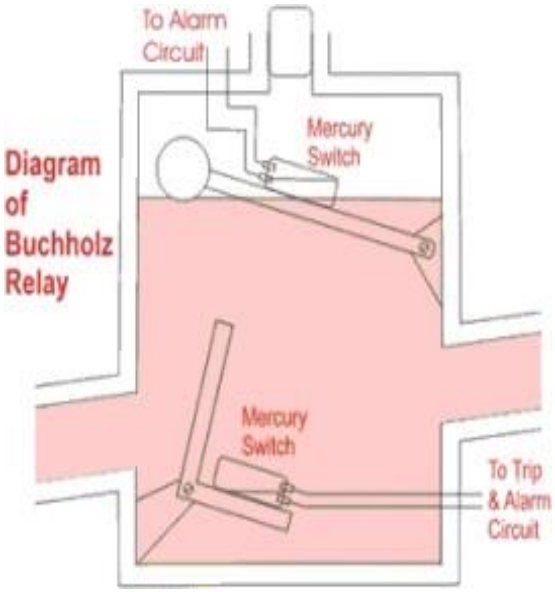
Fall of oil level means lowering the position of the float and thereby tilting the mercury switch. The contacts of this mercury switch are closed and an alarm circuit energized .Sometimes due to oil leakage on the main tank air bubbles may be accumulated in the upper part of the Buchholz container which may also cause a fall of oil level in it and the alarm circuit will be energized. More severe types of faults, such as short circuits between phases or to earth and faults in the tap changing equipment, are accompanied by a surge of oil that strikes the baffle plate and causes the mercury switch of the lower element to close.

Buchholz Relay Operation Certain Precaution

The Buchholz relay operation may be actuated without any fault in the transformer. For instance, when oil is added to a transformer, air may get in together with oil, accumulated under the relay cover, and thus cause a false Buchholz relay operation.

That is why the mechanical lock is provided in that relay so that one can lock the movement of mercury switches when oil is topping up in the transformer.

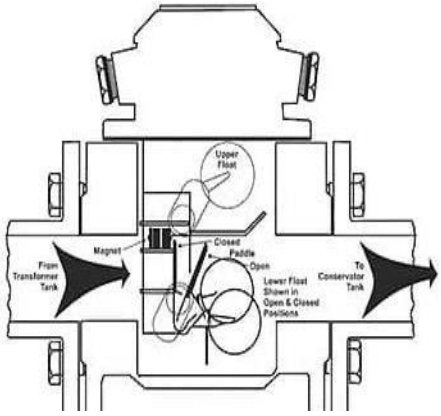
This mechanical locking also helps to prevent unnecessary movement of breakable glass bulbs of mercury switches during transportation of the Buchholz relays.



The lower float may also falsely operate if the oil velocity in the connection pipe through, not due to an internal fault, is sufficient to trip over the float. This can occur in the event of the external short circuit when over currents flowing through the winding cause overheated the copper and the oil and cause the oil to expand. Faults that occur inside an oil-filled transformer generates heat, much enough to decompose the insulating oil. Decomposition of oil produces gases such as hydrogen, carbon monoxide, methane etc. These gases gradually move towards the conservator through the connecting pipe, but a part of which get trapped inside the Buchholz relay. The trapped gases displace oil inside the relay. Hence the level of oil in it falls, activating the float switches inside.

In the case of large faults, a huge amount of gases are produced by the **decomposition of oil.** This results in an oil surge that moves towards the oil

conservator. This oil surge pushes down the flap attached to the transformer side its outlet. This part can be understood only after reading the following sections.The external casing and terminal box of a Buchholz relay are made up of aluminum alloy. It is a weatherproof and oil- tight design that holds inside two float switches, one at the top and the other at the bottom, for sensing oil level and flap to sense oil surge. Two reed switches/mercury switches, one for alarm and the other for circuit breaker trip, are attached to the f loat switch. These switches are connected to the terminals within the terminal box at the top of the relay. An inspection window is provided to monitor the oil level inside it.



The external casing and terminal box of a Buchholz relay are made up of aluminum alloy. It is a weatherproof and oil-tight design that holds inside two float switches, one at the top and the other at the bottom, for sensing oil level and flap to sense oil surge. Two reed switches/mercury switches, one for alarm and the other for circuit breaker trip, are attached to the float switch. These switches are connected to the terminals within the terminal box at the top of the relay. An inspection window is provided to monitor the oil level inside it. The viewing window is fitted with scaled sight glasses which enables the monitoring of the oil level inside the relay.

A gas release cork is provided at its top to expel the accumulated gases. An electrical circuit contact test button and the terminals are enclosed in a weather-resistant cast aluminum alloy terminal box fitted at the top of the relay. A drain cork is provided at the bottom of the casing. The electrical circuitry is Modern relays come with provision for analogue and digital signals option for continuous gas accumulation and flow speed monitoring

The upper reed switch (attached to the upper float switch) is connected to an alarm circuit and lower reed switch (attached to the lower float switch) is connected to the trip circuit of the circuit breaker at the incoming side of the transformer. During large faults, the lower reed switch activates the trip circuit of the circuit breaker and interrupts the power supply to the transformer, thereby avoiding large accident In the case of short circuits, the gas generation is violent and causes oil to rush from the main tank to the conservator. This lowers the flap fitted to the lower float and activates the trip contacts, thereby isolating the input supply to the transformer, avoiding severe faults. This activates the trip contacts and the transformer is disconnected from the supply. This operates the alarm contact. The same thing shall happen if free gases are present in the main tank.

COOLING OF SECURITY CAMERA

MONISA B *ANUNITHA J*

Introduction

The use of outdoor cameras has seen a massive influx with the rise in security monitoring by government and private security agencies. Security cameras are installed with the objective to reduce crime or improving public safety. CCTV around entertainment venues, stadiums, and other commercial and industrial properties. Thermal cameras (infrared sensing) are now often used to improve the facility and border security at night. Most recently, thermal cameras have been implemented to detect people's body temperatures as a security and safety measure in the fight against COVID-19.

Here, Thermoelectric coolers are used to cool the cameras. A Thermoelectric cooler (TEC) is a solid-state device used for precise temperature control. Not only can it cool electronics to nearly 70°C but it can also be used as a heat pump. TECs operate by the Peltier effect, the state of temperatures changing at two electrical junctions due to current flow. By integrating thermoelectric coolers into systems,design engineers are able to heat, cool, and even control temperatures in inclement weather while depleting greenhouse gas emissions.

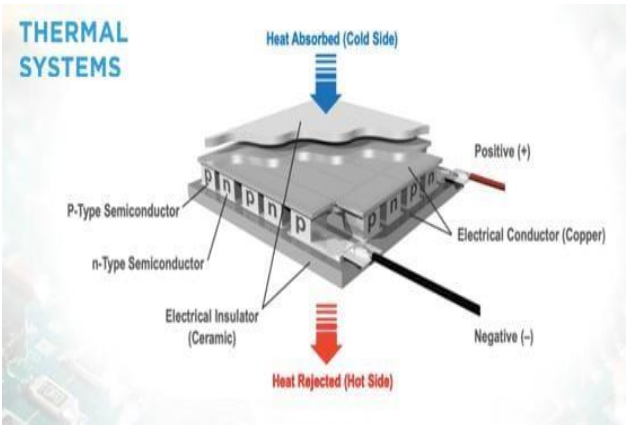
Some IP cameras available on the market today contain coolants to help maintain a proper temperature. The introduction of extreme weather enclosures has helped to ensure that cameras do not overheat when located in hot environments. RBSs are used in almost every electric vehicle and hybrid electric vehicle. In addition, public transportation such as buses and bullet trains make use of RBSs to decrease the environmental impacts of the transportation fleet and save money.

History

In the early 70s, they placed security cameras in problem areas throughout the city to begin tackling crime. In 2019, it's easy to take security cameras and other surveillance equipment for granted. What was once a luxury has practically become a given; now, any public area is likely to be monitored with CCTV cameras, with footage resting a few clicks away. In this timeline, we'll take a look at some of the most significant milestones in CCTV history. CCTV technology was invented by a man named Walter Bruch, initially for the purpose of learning about weapons, not people.

Whether it's heavy rain, ice, snow, or heat, outdoor surveillance cameras are subject to extreme weather conditions that can cause components to fail or freeze. Follow our Top Tips to keep your

CCTV system up and running during the coldest months of the year.



Insulate a security camera

Make a box with a rubber front so that the f ace of the camera sticks out and the rubber forms a seal protecting the inside of the box where there is insulation. On the inside put heat tape or cord they use for pipes or roofs to prevent freezing. Could also look into the heating element used in shoe driers.

To prevent an outdoor surveillance camera f rom being stolen, place it out of arm's reach like up on the walls, soffit, the overhang of the roof, or under the eave mount it into the wall with a screw mount or security mount. HomeAdvisor's Security Camera Installation Cost Guide lists the average price estimates for installing a surveillance system.

Security Cameras in wind

To prevent security cameras from becoming foggy at night, another good solution is to put a small packet of silica gel inside the outdoor CCTV cameras. Such desiccant materials are capable of removing moisture and drying out the air and thus, avoiding CCTV camera condensation problems. If your lens is foggy but you're still out and about shooting, then try hopping inside your vehicle and turn the heater on. Make sure not to put it on full blast – you want just enough heat to gradually bring the core temperature of your camera and lens back up in order to remove the condensation.

Warm the camera in the winter season

Some areas have temperatures that go as low as -40 degrees. As I'm writing this in early January, the temperature in Fairbanks, Alaska, is -31 degrees F/-35 degrees C, while the South Pole is at a relatively balmy -18 degrees F /-28 degrees C. If it gets below - 40 degrees, I'd seriously think about staying indoo rs! Still, most of those problems can be avoided Here are some tips from an expert on how to do winter photography. That is adjusted your camera's exposure during the winter weather.

Most security camera footage is stored for 30 to 90 days. This is true for hotels, retail stores, supermarkets, even construction companies. Banks keep security camera footage for up to six months to comply with industry regulatory requirements.

Thermographic cameras can be broadly divided into two types: those with cooled infrared image detectors and those with uncooled detectors. Cooled detectors exist to maximize detection performance and viewing range.

Depending on the imaging requirements, cameras may contain several CMOS sensors to enhance resolution or capabilities. For example, new 3D cameras have four CMOS sensors

The internal electric power f rom more intricate 3D camera systems can generate more than 60 Watts of heat. Add in solar radiation and the outdoor 3D

camera components are tasked with operating well above their thermal temperature limits. The camera system must be cooled to minimize heat generation, with priorities to cooling each CMOS sensor to below its thermal tolerance in order to optimize image quality. This requires a cooling solution with enough cooling capacity to efficiently cool four sensors and dissipate heat away from all sensitive electronics into the ambient environment.

Cooling of cameras

The use of outdoor cameras has seen a massive influx with the rise in security monitoring by government and private security agencies. the camera technology implemented; it is critical that the optimum operating temperature of sensitive imaging components is maintained during use to ensure high - quality images. Active thermoelectric coolers utilizing the Peltier effect offer advanced thermal management solutions. These thermoelectric devices meet the size constraints and high-temperature rating required for optoelectronics implemented in outdoor security cameras.

Thermal cameras are extremely sensitive to thermal noise. Since thermal cameras are detecting radiated heat, any heat from passive components themselves makes it harder to capture images. Thermal management systems must quickly dissipate heat away from the internal camera components, including the sensor and video processors. High-functioning thermal management systems will enable IR cameras to detect thermal energy with accuracy as fine as 0.025°C. Cooling vital components can result in the creation of condensation. Surfaces exposed to temperatures below dew point will develop unwanted and potentially harmful moisture. Outgassing must be avoided at all costs, as it can fog the security camera lenses. Creating protective exteriors to prevent moisture, condensation, and the ingress of other outside contaminants is critical in protecting sensitive camera electronics.

If the hot side heat sink is at 90ºC, the thermoelectric cooler can cool the CMOS sensor down to a temperature of 40ºC if required. Outdoor CMOS sensor applications require an active cooling solution such as a thermoelectric cooler to keep the device from exceeding its maximum operating temperature. The image quality of a CMOS sensor degrades at temperatures typically in the 50 to 60º C range based on the quality of the sensor. For indoor applications, a free convection heat sink with interface material may be sufficient to cool a CMOS sensor with adequate airflow to just above ambient

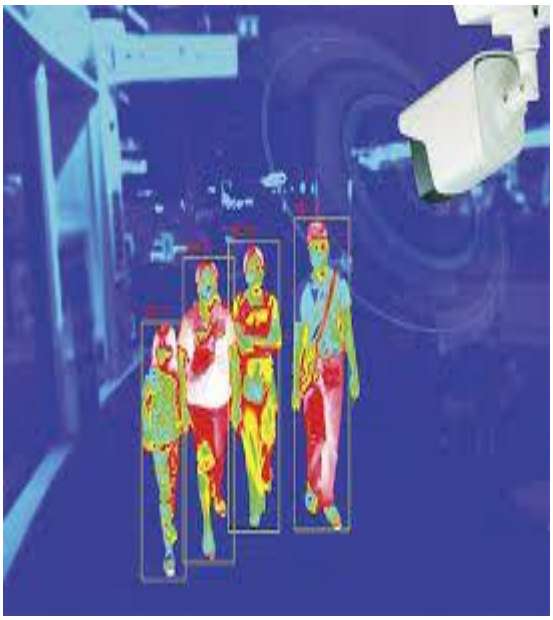
. It's important to design a heat sink with maximum surface-to-air contact to reduce the overall thermal resistance. Typically, space constraints make it difficult to accommodate a properly sized heat sink and forced air is required to keep the temperature just a few degrees above ambient. Monitoring everything is important nowadays, because of theft problems. Humans have invented locks since ancient times, to use and protect their privacy and personal belongings. They are constantly evolving over the ages for better protection. But the problem is that locking the door these days is not safe and

can be easily bypassed. Our doors can be forgotten and this is a common occurrence for most people technology by using a code or phone or by card to make our things safer.

In this modern world, security is employed in all fields. But in rural areas, the protection is not involved up to the maximum level. In addition to this, the above-mentioned problem motivated to do this intelligent tap to overcome the issues faced by the consumers. The security system with acceptable amounts can be determined.

Essentials of Monitoring

CCTV systems are far more effective when monitored. Acting as both a deterrent and active security measure, intrusion and vandalism can be minimized through CCTV monitoring combined with police response. Using the latest CCTV monitoring technology, we deter and stop criminal activity on our customers' sites day and night. Our vigilant monitoring service has noticeably decreased the amount of burglary and criminal damage caused to our customer's secure premises. Through the integration of Public Address (PA) systems, our Operators can instruct intruders that their actions are being recorded, providing live visual data from the received images to confirm their appearance and actions while simultaneously notifying the relevant authorities of the intruder's presence. We operate across a large number of transmission platforms, enabling compatibility with your existing systems. With the help of CCTV cameras, you can keep an eye on what's happening at the business premises. By monitoring, it can help in understanding what's going around on the premises, who's visiting, what the employees are doing, and others. This will help in the long term in maintaining the peace and harmony of company.



Conclusion

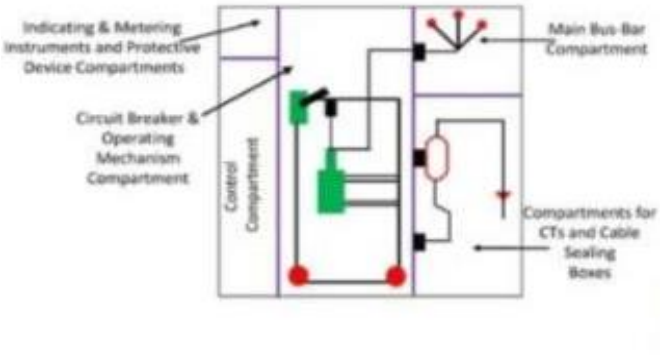
Temperature-sensitive optoelectronics continue to be specified in outdoor applications with worst-case temperatures exceeding 90ºC. Heat fluctuation in these critical systems can cause degradation of performance and even system failure. These devices, like outdoor security cameras, require active cooling to keep below their maximum operating temperature in outdoor environments. However, standard thermoelectric devices cannot operate in these high temperatures either. New materials have been designed into the series that allow it to operate in temperatures up to 150ºC, exceeding most outdoor applications.

INDOOR SWITCHGEAR

SAVURIYAPPAN S *ARVIND KUMAR N*

Introduction

Indoor switchgear is one that is exclusively intended for , wherein it is protected from wind, rain, snow or abnormal dust deposits, abnormal condensations, ice and hoary frost. Indoor switchgear is normally of a metal-clad design. The various components forming the switchgear are arranged in compartments separated by earthed metal partitions. Thus we have a breaker compartment, CT/PT compartment, cable termination compartment, busbar compartment, surge suppressor compartment, LT busbar compartment, instrument panel chamber, etc.



Switchgear is a generalized term given to a unit extra safety compared to the outdoor system which is a combination of protective control and metering types of equipment as a whole. Switchgear can be of different forms depending on the kind of applications such as protection of feeders, protection of motors, rail traction purposes, measurements etc. For example, the switchgear installed in an electrical power substation perform various functions such as connections of incoming feeders and transformer units with the busbar, interruption of short circuit current using combinations of circuit breakers and relaying devices, switching of capacitor banks, measurement of current and voltage, monitoring and control, battery storage, etc. Depending on the voltage levels as well as economic viability, switchgear can be of indoor or outdoor types. The indoor switchgear is mostly used for medium voltages also called MV switchgear and is enclosed in a metal enclosure that is grounded. Voltage levels ranging from 3-36 kV can be termed as medium voltages. However, in recent times indoor switchgear has also been successfully employed for high voltages higher than 36 kV. In the coming sections, we will try to restrict our discussion mainly to the indoor switchgear.

Design of indoor switchgear

Compared to outdoor switchgear, the indoor switchgear is mostly gas insulted system or GIS, as compared to an air-insulated system. GIS is employed where the cost of land is more, and air is corrosive and dust-laden. The switchgear arrangement is enclosed in a grounded metal enclosure on all the sides provided with openings for ventilation and inspection. The switchgear units are insulated in a gas environment

The dielectric strength of SF6 is about three times that of air. The metal enclosure provides **Metal Enclosed Switchgear**

The switchgear arrangements are enclosed on all sides with metal sheets containing primary interrupting devices and fuses, and all the pieces of equipment are encased in a central assembly. Doors and removable coverings provide the access to the interior of the enclosure. The fig.1 shows an image of a metal enclosed type indoor switchgear system**.**

Metal Clad Switchgear

In metal-clad switchgear, the circuit breaker are normally vacuum type and are withdrawable or drawn out type. Relaying and metering instruments are isolated by grounded metal barriers separately. Voltage levels for metal-clad switchgear ranges from 4.76kV to 38kV with main bus continuous ratings of 1.2kA 2kA 3kA and 4kA. In general, all metal-clad switchgears are metal enclosed but all metal-enclosed are not metal clad switchgears. The metal-enclosed switchgear is of same voltage rating as that of metal- clad but is of simpler construction. The metal-clad switchgear is advantageous over metal-enclosed

switchgear because the former is highly customizable.

The earliest central power stations used simple open switches mounted on insulating panels of. Power levels and voltages rapidly escalated, making opening manually operated switches too dangerous for anything other than gears of a de-energized circuit. Oil-filled switchgear equipment allows arc energy to be contained and safely controlled. By the early 20th century, a switchgear line-up would be a metal-enclosed structure with electrically operated switching elements using oil circuit breakers. Today, oil-filled equipment has largely been replaced by air-blast, vacuum, or sf equipment, allowing large currents and power levels to be safely controlled by automatic equipment.

High-voltage switchgear was invented at the end of the 19th century for operating motors and other electric machines. The technology has been improved over time and can now be used with voltages up to 1,100 kV

Typically, switchgear in substation is located on both the high- and low-voltage sides of large power transformer. The switchgear on the low-voltage side of the transformers may be located in a building, with medium- voltage circuit breakers for distribution circuits, along with metering, control, and protection equipment. For industrial applications, transformer and switchgear line- up may be combined in one housing, called a unitized (USS). According to the latest research by Vision gain, a market research company, the worldwide switchgear market is expected to achieve $152.5 billion by 2029 at a CAGR of 5.9%. Growing investment in renewable energy and

enhanced demand for safe and secure electrical distribution systems are expected to generate the increase. One of the basic functions of switchgear is protection, which is interruption of short-circuit and overload fault currents while maintaining service to unaffected circuits. Switchgear also provides isolation of circuits from power supplies enhance system availability by allowing more than load. It is very much required to establish an energy at load center. Since, establishing a substation at load center is quite economical and profitable in many aspects. As it reduces length of feeders and due to short length feeders, the quality of voltage regulation improves. But the main obstruction of establishing a substation at load center is space. Generally main load center of any place is situated at very congested place where, sufficient land for establishing conventional electrical substation is very hardly available

Isolated Phase GIS

In this configuration, each phase of the bay is assembled separately. That is, for each phase, one pole of circuit breaker, a single pole of electrical isolator, one phase assembly of current transformer are assembled together. This type of GIS requires larger bay width as compared to other gas insulated switchgear system.

Integrated 3 Phase GIS

In this configuration all three phase of circuit breaker,3 phases of disconnectors and three phase current transformer are encapsulated in an individual metal enclosure. The arrangement forms a three phase module for the element. The size of this type of module is one third of the isolated phase GIS. It is a suitable combination of isolated phase and three phase common elements. Here three phase common bus bar system simplifies the connection from the busbar. The isolated phase equipment prevents phase to phase faults. This is an optimum design considering, both facts in mind, i.e. space requirement and maintenance facility.

In this GIS or gas insulated switchgear systemthan one functional element are encapsulate in a single metal enclosure. For example, in some design, a three phase circuit breaker, current transformer, earth switches, even other feeder elements are covered together in a single metal capsule.

This design was introduced in the year of 2000, where, total substation equipment are encapsulated together in single enclosure housing. This single unit gas insulated substation has gained user appreciation as it is a complete solution for an outdoor substation, in a single unit. As such, only equipment (HIS) is substitute of a total outdoor switch yard.

PORTABLE SOLAR MOBILE CHARGER

SARATHIVASAN J *NANDHAKUMAR L*

Introduction

Portable Solar Mobile Phone Charger is a power electronic device that converts the sun's radiation into electrical energy for the purpose of charging the batteries of mobile phones. It does this by converting, controlling and conditioning the flow of electrical energy from source (solar panel) to load (mobile phone) according to the requirements of the load.

In a densely populated, poverty stricken country with a population of over 160 million people in the case of Nigeria, it is unarguable that the epileptic state of power supply is an issue of great concern to Nigerians. Citizens find it very difficult to charge their phones when they eventually have a flat battery. We are now left with the option of putting on a generating set (Generator) which causes air pollution and depletion of the atmospheric ozone layer (green house effect), generators are also very expensive to operate due to the hike in price of petrol in the country[2]. The option of charging through public charging centers is inconvenient as most times these centers are crowded and employ the use of a generator as well.

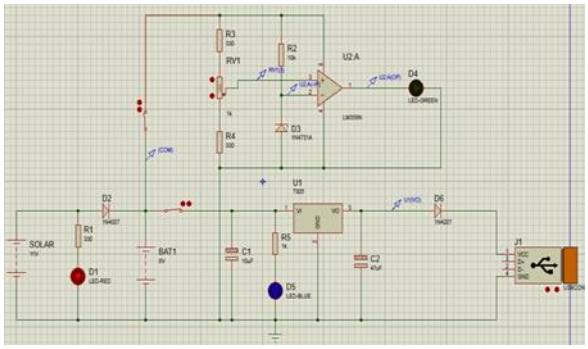
Theft of mobile phones is prevalent with charging centers and fire outbreaks in many cases due to overload of supplying cables and very unprofessional connections done in order to realize The aim of this project is to design and construct a portable solar mobile phone charger.In order to achieve this aim, the following objectives were set;

i. To construct the designed solar mobile phone charger.
ii. To evaluate the performance of the designed charger.

Design Background

This idea was suggested by his teacher on Applied Science Research, Dr. James Dann. Ali Nahm had interest in the project because he wanted to solve the problem of people always getting frustrated when they cannot contact friends because (takes six to eight hours) to get mobile phones charged fully of a dead phone.

The backpack built stores energy from solar cells placed on its exterior which could then be used to charge peoples' electronic devices, such as cell-phones and iPod. He did this by using four blocks of three solar cells in parallel which made up a panel and the panel is connected to the charging circuit which has a voltage regulator within. He also explored the use of two ultra- capacitors to help store charges and a backup battery for storing power as well

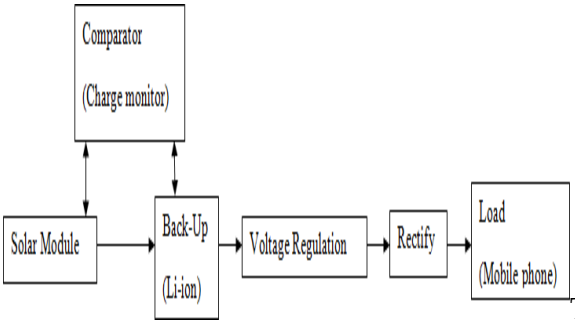


However, this system has a challenge, specific 550Ω resistor was used in the voltageregulator circuit instead of a potentiometer.

so that a user can vary the output voltage setting and charge different devices.

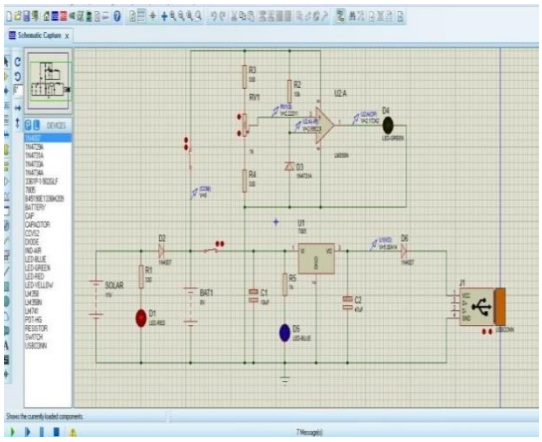
Presents a proposed system titled "Mobile Charger Based on Coin by using Solar Tracking System". This paper describes the mobile charger using solar tracking system with coin as the method of payment. This is designed based on ATMEL 89c51 a 40-pim microcontroller that does the count-down timings with LCD display showing the actual time left. Light sensors (Light Dependent Resistors) are placed for detecting the intensity of radiation thereby sending this data to the microcontroller so that the drivers move the panel for efficient solar tracking. Lead acid battery is used for backup (that is, storing power). A coin-based IR sensor detects coin to be placed for service payment. A 37W solar panel capable of On the other hand, it is not absolutely excellent as its weakness is that it is bulky, as a large-sized solar panel was used and this is owing to the large power requirements of components as the motor drivers.Presents a work titled "Solar Mobile Charger". This paper presents the design of a solar mobile charger meant for recharging the batteries of mobile phones. The proposed system consists of AC input, main input unit, DC input from solar cell and battery for storage. A PIC microcontroller 16F877A was used as the CPU. There is an LCD display which shows all parameters relating to battery

METHODOLOGY



The method used in realizing this device is in terms of modular design and implementation and carried out in the laboratory in the year 2016. This system consists of units and blocks which make up the entire solar charging device. Figure 1 shows a well simplify blockdiagram of the system. The power source of this system is solar radiation that is converted into electricity by a solar panel. The supply received from the solar panel's output is a DC. DC-DC conversion using a power electronic converter called a chopper is used to provide the regulated power to the backup for storage. It is the backup that in turn charges the mobile phone. The

backup system consists basically of two lithium ion batteries



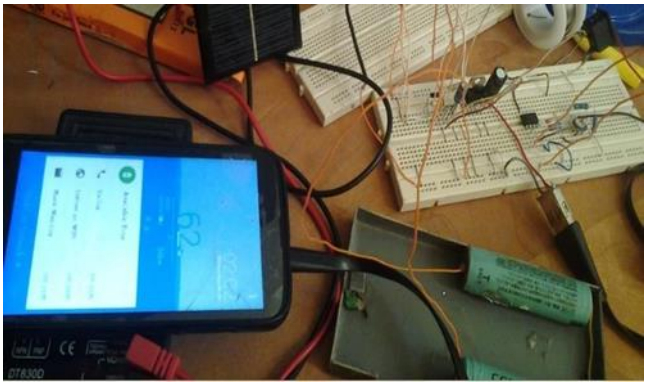
Solar Module- The solar module consists of two 5.5V operating voltage solar panels connected in series to give 11V operating voltage A current value of 160mA is obtained and used to charge the back- up Li-ion batteries. For current to flow from source to sink, the source voltage must be higher than the sink voltage. Therefore, 11V at source pushes 160mA current to charge battery rated 8V. electrical energy and charging the back-up. R1 is a small-valued 330Ω fixed resistor that limits current flow to the LED D1. D2 is a blocking diode (1N4007) that ensures current does not flow in the reverse direction to the solar panel in order to avoid damage to the panel. So, D2 ensures flow of current only to the back-up and otherwise is not permitted

Back-Up Module

The back-up module consists of two 3.7V Lithium-ion batteries connected in series to give a total voltage of 7.4V and 8V when fully charged. As one 3.7V Li-ion battery gets to 4.2V when fully charged. The blocking diode, D2 ensures current delivery to the back-up. The switch on the right hand deliver power to the regulator circuit

Breadboard Test

Components were connected to form the overall circuit on a breadboard as shown in Figure 5 for a more reliable test; this is as a result of the inconsistencies in simulations by Proteus.small panel used are: operating current; 160mA, floating current; 200mA. Operating voltage; 5.5V. Dimension; 63 by 63mm.Output current through USB female connector to the mobile phone at a load voltage of 3.7V



Conclusion

The working circuit was designed and simulated on the ISIS environment of Proteus simulator. The simulation is captured while running and shown in Figure 4. Virtual Ammeter was placed in series with the load to measure the current through, which is 884mA. A Voltmeter from the Proteus environment was connected in parallel to the load to measure the voltage across the load terminals as 5V.

HARMONIC CURRENT IN POWE SUPPLIES

NANDHAKUMAR J *BOOPATHIRAJ K*

Introduction

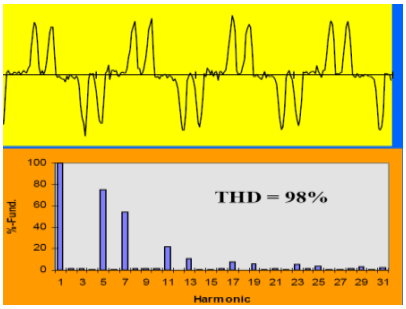
Harmonics are a distortion of the normal electrical current waveform, generally transmitted by nonlinear loads. Switch-mode power supplies (SMPS), variable speed motors and drives, photocopiers, personal computers, laser printers, fax machines, battery chargers and UPSs are examples of nonlinear loads .

Harmonic currents, generated by non-linear electronic loads, increase power system heat losses and power bills of end-users. These harmonic-related losses reduce system efficiency, cause apparatus overheating, and increase power and air conditioning costs. As the number of harmonics-producing loads has increased over the years, it has become increasingly necessary to address their influence when making any additions or changes to an installation. Harmonic currents can have a significant impact on electrical distribution systems and the facilities they feed. It is important to consider their impact when planning additions or changes to a system. In addition, identifying the size and location of non-linear loads should be an important part of any maintenance, troubleshooting and repair program.

The trouble with harmonics in modern power systems

Harmonics are a distortion of the normal electrical current waveform, generally transmitted by nonlinear loads. Switch-mode power supplies (SMPS), variable speed motors and drives, photocopiers, personal computers, laser printers, fax machines, battery chargers and UPSs are examples of nonlinear loads. Single-phase non-linear loads are prevalent in modern office buildings, while three-phase, non- linear loads are widespread in factories and industrial plants. A large portion of the non-linear electrical load on most electrical distribution systems comes from SMPS equipment. For example, all computer systems use SMPS that convert utility AC voltage to regulated low-voltage DC for internal electronics. These non-linear power supplies draw current in high-amplitude short pulses that create significant distortion in the electrical current and voltage wave shape—harmonic distortion, measured as total harmonic distortion (THD). The distortion travels back into the power source and can affect other equipment connected to the same source.

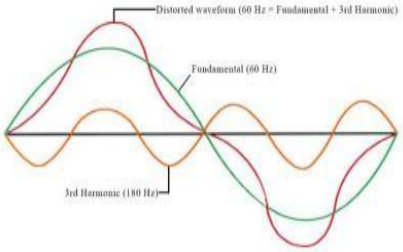
Harmonics are currents or voltages with frequencies that are integer multiples of the fundamental power frequency. If the fundamental power frequency is 60 Hz, then the 2nd harmonic is 120 Hz, the 3rd is 180 Hz, etc



When harmonic frequencies are prevalent, electrical power panels and transformers become mechanically resonant to the magnetic fields generated by higher frequency harmonics. When this happens, the power panel or transformer vibrates and emits a buzzing sound for the different harmonic frequencies. Harmonic frequencies from the 3rd to the 25th are the most common range of frequencies measured in electrical distribution systems All periodic waves can be generated with sine waves of various frequencies. The Fourier theorem breaks down a periodic wave into its component frequencies. The total harmonic distortion (THD) of a signal is a measurement of the harmonic distortion present and is defined as the ratio of the sum of the utility power through a transformer that steps it down to 208- volt AC power that feeds racks of servers. One or more power supplies within each server convert this AC input into DC voltage appropriate for the unit's internal components powers of all harmonic components to the power of the fundamental

Distorted waveform composed of fundamental and 3 rd harmonic

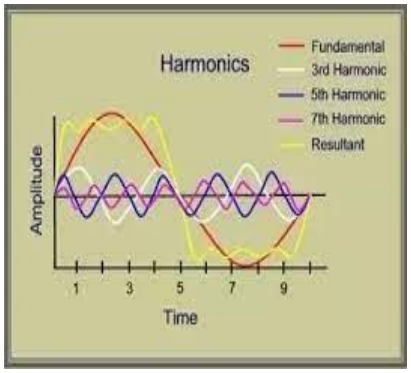
In modern facilities, the neutral wiring should always be specified to be the same capacity as the power wiring, or larger—even though electrical codes may permit under-sizing the neutral wire. An appropriate design to support a load of many personal computers, such as a call center, would specify the neutral wiring to exceed the phase wire capacity by about 200 percent. Particular attention should be paid to wiring in office cubicles. Note that this approach protects the building wiring, but it does not help protect the transformer



In the typical data center, the power distribution system converts 480-volt AC. Heat dissipation also limits the number of servers that can be housed in a data center. Could it be worthwhile to eliminate this step by switching to DC power? According to a recent article in Energy and Power Management magazine, "Computers and servers equipped with DC power supplies instead of AC power supplies produce 20 to 40 percent less heat, reduce power consumption by up to 30 percent, increase server reliability, offer flexibility to installations, and experience decreased maintenance requirements." That sounds good, but when cost, compatibility, reliability and efficiency are considered together, the move from AC to DC power is not justified for most data centers. AC power— even though it is slightly less efficient—is universally acceptable to existing equipment. Furthermore, there are no Underwriter's Laboratory (UL) safety standards for high-voltage DC in data centers yet, while standards for AC systems are mature. That means the safety risks could outweigh the potential gain with DC power.

Use K-rated transformers in power distribution components.

A standard transformer is not designed for high harmonic currents produced by non-linear loads. It will overheat and fail prematurely when connected to these loads. When harmonics were introduced into electrical systems at levels that showed detrimental effects (circa 1980), the industry responded by developing the K-rated transformer. K-rated transformers are not used to handle harmonics, but they can handle the heat generated by harmonic currents and are very efficient when used under their K-factor value. K- factor ratings range between 1 and 50. A standard transformer designed for linear loads is said to have a K-factor of 1. The higher the K-factor, the more heat from harmonic currents the transformer is able to handle. Making the right selection of K- factor is very important, because it affects cost and safety. Use Power ware power distribution units (PDUs) with harmonic-mitigating transformers. The K- rated, dry-type transformer is widely used in electrical environments, but there have been more recent advancements in transformer design that offer even better performance in reducing voltage distortion and power losses due to current harmonics. Eaton's energy-efficient Harmonic Mitigating Transformer (HMT) is designed to handle the non-linear loads of today's electrical infrastructures.



This transformer uses electromagnetic mitigation to deal specifically with the triple (3rd, 9th, 15th, etc.) harmonics. Secondary windings of the transformer are arranged to cancel zero sequence fluxes and eliminate primary winding circulating currents. This transformer also addresses the 5th and 7th Harmonic currents can have a significant impact on electrical distribution systems and the facilities they feed. It is important to consider the impact of harmonics when contemplating additions or changes to a system. In addition, identifying the size and location of non-linear with built-in harmonic ratio function, the Agilent U1242 Series handheld DMM helps technicians and engineers quickly verify the presence of harmonics in AC signals. This information can be used to prevent or reduce equipment downtime and repair costs.

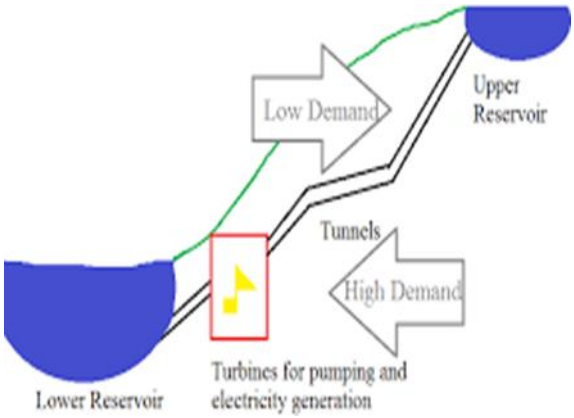
A harmonics analyzer is the most effective instrument for performing detailed analysis of power quality to determine the wave shapes of voltage and current on respective frequency spectrums. A harmonics analyzer is used to provide a detailed analysis of the suspect source. Using this data, the harmonic ratio function calculates a value from 0% to 100% to indicate the deviation of non-sinusoidal and sinusoidal waveform. This value indicates the presence of harmony

PUMPED HYDROELECTRIC ENERGY STORAGE

VIJAY E *PRAVEENA M*

Introduction

In the last decade, interest in bulk Electrical Energy Storage (EES) technologies has grown significantly as a potential solution to some of the challenges associated with de carbonising electrical energy systems. The transition from systems that are primarily reliant on carbon intensive fossil fuels to those which use greater amounts of lower-carbon energy sources like renewables and nuclear energy is a broadly accepted policy choice of many countries around the world, although the exact technology choices, the speed of the transition and the level of ambition vary widely

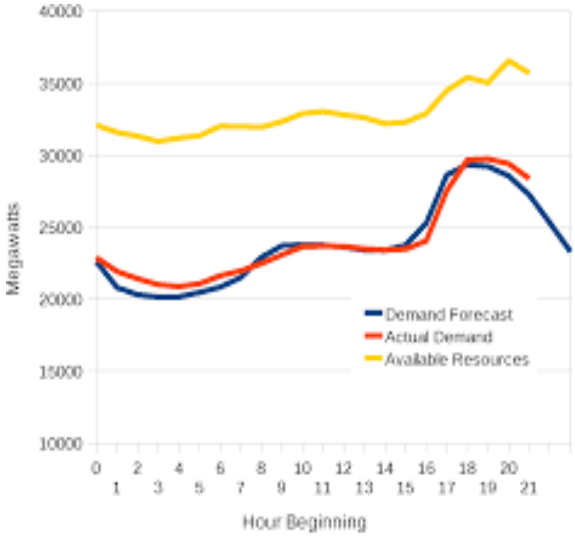


The de carbonization policies are a response to the compelling evidence around the risks of anthropogenic climate change, and the need to decouple economic growth from environmentally damaging impacts. One of the greatest challenges of many low-carbon generation technologies is that they lack a similar level of load-following flexibility compared to conventional fossil fuel based power generation. This is especially true of renewable generation that is weather dependent. For example, the wind and solar primary energy resources are variable, often unpredictable (when the forecast window to real time is stretched), and crucially lack the intrinsic energy storage associated with fuel-based generation. Therefore, while weather dependent renewable generation can generally be turned down (curtailed) if demand is low, it lacks load-following flexibility as it cannot be turned up if the primary energy source is unavailable. Simply put, it is not possible to store these primary energy resources, e.g. one cannot store the wind as wind or the sunlight as sunlight. This is a simple but powerful concept as intrinsic energy storage is a defining characteristic of any fuel. Fossil fuels in particular are a major part of the primary energy supply of most electrical systems due to their cost, availability, energy density, ease of storage, ease of handling and ease of transportation.

ECONOMIC EFFICIENCY

Taking into account evaporation losses from the exposed water surface and conversion losses, energy recovery of 70–80% or more can be achieved. This technique is currently the most cost-effective means of storing large amounts of electrical energy, but capital costs and the presence of appropriate geography are critical decision factors in selecting pumped-storage plant sites. The relatively low energy density of pumped storage systems requires either large flows and/or large differences in height between

reservoirs. The only way to store a significant amount of energy is by having a large body of water located relatively near, but as high above as possible, a second body of water. In some places this occurs naturally, in others one or both bodies of water were man-made. Projects in which both reservoirs are artificial and in which no natural inflows are involved with either reservoir are referred to as "closed loop" systems.



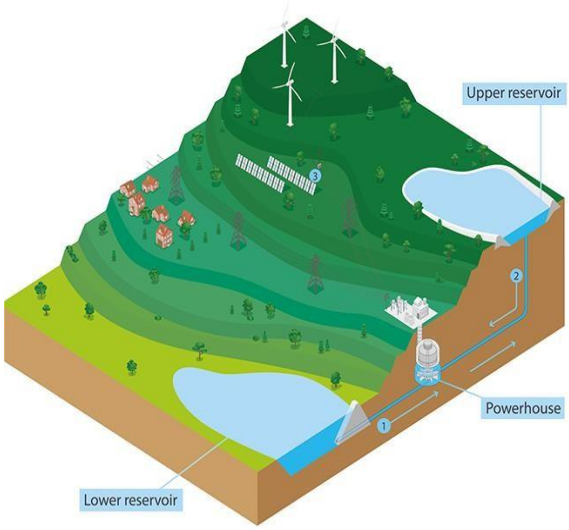
These systems may be economical because they flatten out load variations on the power grid, permitting thermal power stations such as coal-fired plants and nuclear power plants that provide base-load electricity to continue operating at peak efficiency, while reducing the need for "peaking" power plants that use the same fuels as many base-load thermal plants, gas and oil, but have been designed for flexibility rather than maximal efficiency. Hence pumped storage systems are crucial when coordinating large groups of heterogeneous generators. Capital costs for pumped-storage plants are relatively high, although this is somewhat mitigated by their proven long service life of decades - and in some cases over a century, which is three to five times longer than utility-scale batteries

When Electricity prices become negative, pumped hydro operators may earn twice - when "buying" the electricity to pump the water to the upper reservoir at negative spot prices and again when selling the electricity at a later time when prices are high. Along with energy management, pumped storage systems help control electrical network frequency and provide reserve generation. Thermal plants are much less able to respond to sudden changes in electrical demand, potentially causing frequency and voltage instability. Pumped storage plants, like other hydroelectric plants, can respond to load changes within seconds.

Potential technologies

In March 2017 the research project St En Sea (Storing Energy at Sea) announced their successful completion of a four-week test of a pumped storage underwater reservoir. In this configuration a hollow sphere submerged and anchored at great depth acts as the lower reservoir, while the upper reservoir is the enclosing body of water. Electricity is created when water is let in via a reversible turbine integrated into the sphere. During off-peak hours the turbine changes direction and pumps the water out again, using "surplus" electricity from the grid. The quantity of power created when water is let in grows proportionally to the height of the column of water above the sphere, in other words: the deeper the sphere is located, the more densely it can store energy. As such the energy storage capacity of the submerged reservoir is not governed by the

Gravitational energy in the traditional sense, but rather by vertical pressure.

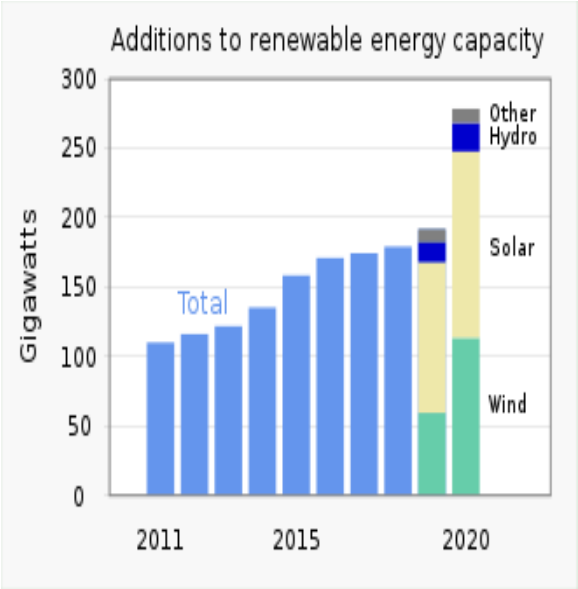


Advantages:

- ✓ No land area is required,
- ✓ No mechanical structure other than the electrical cable needs to span the distance of the potential energy difference,
- ✓ In the presence of sufficient seabed area multiple reservoirs can scale the storage capacity without limits,
- ✓ Should a reservoir collapse, the consequences would be limited apart from the loss of the reservoir itself,
- ✓ Evaporation from the upper reservoir has no effect on the energy conversion efficiency,
- ✓ Transmission of electricity between the reservoir and the grid can be established from a nearby limiting transmission loss and obviating the need for onshore cabling permits.

WORLD WIDE USE

In 2009, world pumped storage generating capacity was 104 GW. while other sources claim 127 GW, which comprises the vast majority of all types of utility grade electric storage. The EU had 38.3 GW net capacity (36.8% of world capacity) out of a total of 140 GW of hydropower and representing 5% of total net electrical capacity in the EU. Japan had 25.5 GW net capacity (24.5% of world capacity).In 2010 the United States had 21.5 GW of pumped storage generating capacity (20.6% of world capacity). PSH contributed 21,073 GWh of energy in 2020 in the United States, but −5,321 GWh (net) because more energy is consumed in pumping than is generated. Nameplate pumped storage capacity had grown to 21.6 GW by 2014, with pumped storage comprising 97% of grid-scale energy storage in the United States.



As of late 2014, there were 51 active project proposals with a total of 39 GW of new nameplate capacity across all stages of the FERC licensing process for new pumped storage hydroelectric plants in the United States, but no new plants were currently under construction in the United States at the time

IOT BASED AUTOMATED STREET LIGHTING SYSTEM

SRIDHAR D *RENUGADEVI N*

Introduction

Internet of Things (IoT) is the networking of physical objects that contain electronics embedded within their architecture in order to communicate and sense interactions Amongst each other or with respect to the external environment. In the upcoming years, IoT-base technology will offer advanced levels of services and practically change the way people lead their daily lives.

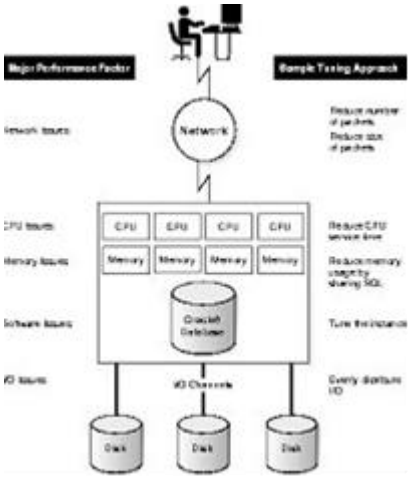
Advancements in medicine, power, gene therapies, agriculture, smart cities, and smart homes are just a very few of the categorical examples where IoT is strongly established. With increment in urbanization and improvement of the city life, the utilization of street lighting is expanding day by day

Automated Street Lighting System

Smart Street light is a robotized framework which automate the road. The primary point of Smart Street light is to reduce the power utilization when there are no vehicle moments on road. The Smart road light will turn to be ON when there are vehicles out and about generally the lights will be turned OFF. With improvement in technology, things are getting to be easier and simpler for everybody around the world today. Robotization is the utilization of control frameworks and information technologies to decrease the requirement for human work in the production of service and enterprises. In the extent of industrialization, robotization is a stage past mechanization, though motorization gave human operators apparatus to help the clients with the solid prerequisites of work, robotization enormously diminishes the requirement for human sensory and mental requirements also. Automation play a vital job on the world's economy and in day by day experience. Programmed frameworks are being favored over manual framework recusing and saving which is accomplished by detecting a moving toward vehicle utilizing the IR sensors and after that exchanging ON a block of road lights in front of the vehicle

Existing System

Industry of road lighting frameworks are developing quickly and going with fast development of industry and urban area. Mechanization, Power utilization and Cost Effectiveness are the imperative contemplations in the present field of gadgets and electrical related advances. To administer and keep up complex road lighting frame of reference all the more financially, different road light control frameworks are created.



These frameworks are created to control and diminish vitality utilization of a town's open lighting framework utilizing distinctive advancements.

The current work utilizes the high power release light (HID). Stowed away by and utilized for urban road light and is dependent on rule of gas release, In this manner the power isn't been controllable by any voltage decrease technique as the release path is broken. HID lamps are a category of electrical gas remittance lamp which bring forth light by means of an electric arc in middle of tungsten electrodes resided inside a translucent or crystalline fused quartz or inter fuse alumina arc tube. Gas and metal salts are recycled to permeate the tube. The arc's fundamental opening is done with the benefit of gas. Once the arc is initialized, it heats and disperse the metal salts materializing plasma, the plasma thus generated greatly boosts the concentration of light emitted by the arc and power consumption is curtailed. Arc lamps belongs to the category of high intensity exoneration lamps. he existing system possess the main disadvantage of want of people to turn off and on the street lights to hand- operate which, requires formidable human competency to monitor the process.

Also, we need to check regularly weather all the street lights are functioning properly or not

Infrared LED:

Infrared LEDs are typically made of gallium arsenide or aluminium gallium arsenide. hey, alongside IR recipients, are generally utilized as sensors. Its appearance is same as a typical LED. Since the human eye can't see the infrared radiations, it isn't feasible for an individual to recognize whether the IR LED is working or, much the same as a typical LED.

Micro Controller

With a domestic core of 8000 bytes, 8-bit microcontroller which is of CMOS based, and embedded system programmable Flash memory acknowledged as AT89S52 is tuned to account which is of subsided power and immense attainment. By bringing together an adaptive 8- bit CPU with embedded programmable on a firm chip of Flash category, the Atmel AT89S52 is an authenticated microcontroller which accommodates a highly-formable and cost compelling explanation to many embedded controlapplications.TheAT89S52accommoda te the typical features of 16 bit counter and timers which are three in number, 32 Input and Output lines, timer with logic of Watchdog, two data pointers, 256 bytes of Main Memory, with two-level implementation of a six-vector interrupt architecture, clock circuitry, serial port with full duplex nature and an oscillator. In extension, the AT89S52 is originated with constant logic of operation which is down to zero prevalence and

comforts two power saving modes which are software selectable.

Lamp Unit

It consists of power adjustable LED array, the brightness sensor, the motion sensor, the communication device such as zig bee module and the controller. To detect the motion in defined area, it is on for several minutes so that motion can be detected by sensors along with its own sensor. It turns off or reduced power under the condition that any motion in not detected in the defined area.

Sensor Unit

It dwells of controller, motion sensor, and the communication device. As soon as motion is detected message communicated to other units. This unit can be placed in many regions such as electric poles, house gates etc to assure that every street light turns on or off.

Methodology and Results

When the IR sensor detects the vehicle moment on the road it sends the signal to the microcontroller where the microcontroller turns the street light on. If the vehicle detection was not there then the street lights still glows but glows with only ¼ intensity of light. If the moment of vehicle was detected then the street light glows with 100% intensity. The proposed method was depicted. The IR transmitter is put straight forwardly in viewable pathway with IR sensor, so the IR receiver persistently gets infrared beams. When the IR collector gets infrared beams, the microcontroller will detect Logic 1. If the infrared beams are hindered by certain means the microcontroller will identify logic 0. Thus, the program for the microcontroller must be written so that it will turn ON the LEDs, which implies here the road light, when it identifies Logic 0 and it will turn off the LEDs, when it recognizes Logic 1. Consider the two IR sensors for example IR Transmitter and IR Receiver are set on the either side of the street. According to the circuit graph, the IR collectors are associated with the PORT0 and the LEDs are associated with the PORT2 of the microcontroller.

Conclusion

This article explains the design and improvement of Smart Street lighting control system circuit. Circuit meets desires suitably to turn street light ON/OFF. In the wake of designing the circuit which controls the light of the street as outlined in previously sections. LDR sensor and the item sensors are the two basic conditions in satisfying the desires of the circuit. In case the two conditions have been satisfied the circuit will do the needed work as demonstrated by the specific framework. Each sensor controls the killing ON or the lighting section. The street lights have been successfully constrained by Microcontroller. With requests from the controller, the lights will be ON in the spots of the developments. Finally, this control circuit can be used as a piece of a long roadway between the urban zones just as the provincial zones.

HYTERESIS MOTOR

NAVEEN N *VIGNESH P*

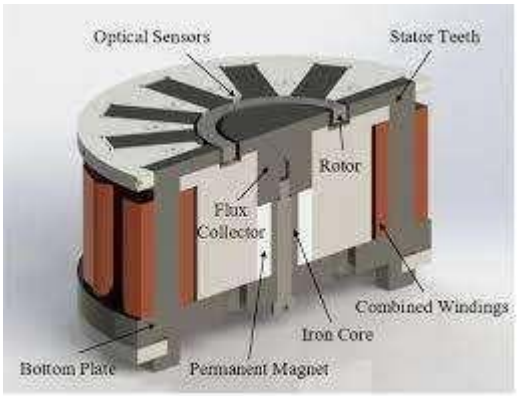
Introduction

The hysteresis motor is an alternating current motor of the rotating magnetic field type. A Hysteresis motor is a self- starting synchronous motor with a uniform air gap and without DC excitation that uses the hysteresis characteristics of magnetic materials to make torque. It widely finds use in synchronous motor applications where very smooth soft torque and simple construction with conventional three- phase stator windings are required. In this article, we are giving an overview of the hysteresis motor, its construction, different types, operation, advantages and disadvantages, and its applications. Read this new blog in Lin quip to find out more.

Components of hysteresis motor:

Stator: It is designed in a particular manner to produce a synchronous revolving field from a single-phase supply. The stator carries two windings; main winding and auxiliary winding. In another type of design of the hysteresis motor, the stator holds the poles of shaded type.

Rotor: The rotor of a hysteresis motor is made of a magnetic material like chrome steel or alnico for high retentivity that has high hysteresis loss property. Example of this type of materials is chrome, cobalt steel or alnico or alloy. Hysteresis loss becomes high due to a large area of the hysteresis loop. In a hysteresis motor the rotor does not carry any winding or teeth.



The applications of hysteresis loss include the following. The hysteresis loop provides the data of coercivity, retentivity, susceptibility, permeability & loss of energy throughout a single cycle of magnetization for every ferromagnetic materiel

HYTERESIS MOTOR

Operation:

A hysteresis motor works on the principle of hysteresis losses; it is a loss that occurs due to magnetization and demagnetization of the material depending on the direction of flow of current. The

following describes the basic functioning of a hysteresis motor.

When the stator is energized, it produces a rotating magnetic field. The main and auxiliary, both windings must be supplied continuously at the start as well as in running conditions to maintain the rotating magnetic field. The rotor, initially, starts to rotate due to eddy-current torque and hysteresis torque developed on the rotor. Once the speed is near synchronous the stator pulls the rotor into synchronism. In such a case, as relative motion between stator field and rotor field vanishes, so the torque due to eddy currents vanishes. When the rotor is rotating at the synchronous speed, the stator revolving field flux produces poles on the rotor. Due to the hysteresis effect, the rotor pole axis lags behind the axis of the rotating magnetic field. Because of this, rotor poles get attracted towards the moving stator poles. Thus, rotor gets subjected to torque called hysteresis torque. This torque is constant at all speeds. When the stator field moved forward, due to high residual magnetism the rotor pole strength remains maintained.

Application:

Electric clocks

Teleprinters

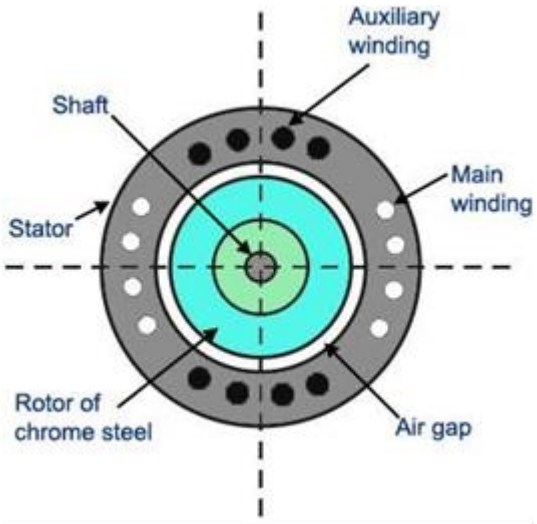
Timing devices

Condition of hyteresis motor:

At the Starting Condition,

When stator is energized with single phase AC supply, rotating magnetic field is produced in stator.

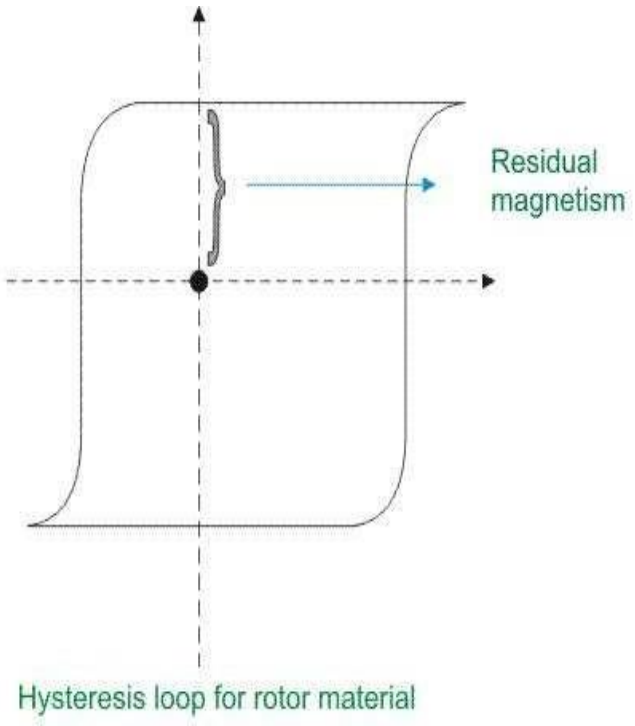
To maintain the rotating magnetic field the main and auxiliary windings must be supplied continuously at start as well as in running conditions.



At the starting, by induction phenomenon, secondary voltage is induced in the rotor by stator rotating magnetic field. Hence eddy current is generated to flow in the rotor and it develops rotor. The rotor goes under the slip frequency before going to the steady state running condition.

So, it can be said that when the rotor starts to rotate with the help of these eddy current torque due to induction phenomenon, it be halves like a single phase induction motor. At Steady State Running Condition, When the speed of the rotor reaches near about the synchronous speed, the stator pulls the rotor into synchronism. At the condition of synchronism, the relative motion between stator field and rotor field vanishes. So, there is no further induction phenomenon to continue. Hence no eddy current to generate in the rotor. Thus, the torque due to eddy-currents vanishes. The maximum work done to establish the hysteresis losses under the magnetization cycle in the rotor is

equal to the surface area inside B-H hysteresis curve.

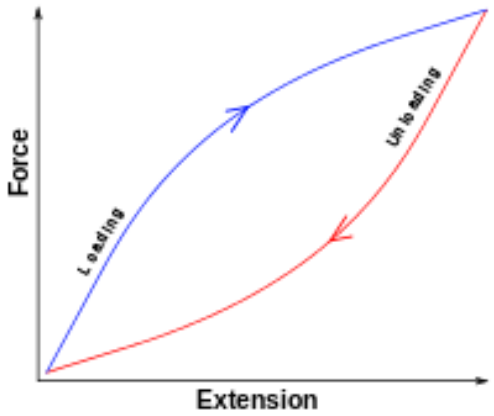


Hysteresis Power Loss

Hysteresis power loss in the rotor of the hysteresis motor is given by

$$P_h = k_h f_r B_{max}^n$$

Hysteresis loss in a transformer occurs due to magnetization saturation in the core of the transformer. Magnetic materials in the core will eventually become magnetically saturated when they are placed in a strong magnetic field, such as the magnetic field generated by an AC current.As a general term, hysteresis means a lag between input and output in a system upon a change in direction. Hysteresis is something that happens with magnetic materials so that, if a varying magnetizing signal is applied, the resulting magnetism that is created follows the applied signal, but with a delay.



Types of hysteresis motor:

There are various types of hysteresis motor by construction. They are:

- Cylindrical hysteresis motors: It has cylindrical rotor.
- Disk hysteresis motors: It has annular ring shaped rotor.
- Circumferential-Field hysteresis motor: It has rotor supported by a ring of non- magnetic material with zero magnetic permeability.

Axial-Field hysteresis motor: It has rotor supported by a ring of magnetic material with infinite magnetic permeability

Advantages:

As no teeth and no winding in rotor, no mechanical vibrations take place during its operation. Its operation is quiet and noiseless as there is no vibration.It is suitable to accelerate inertia load. The loss of hysteresis is shown by a decreased area of the hysteresis loop. The relevance of retentively and coactivity is provided by the hysteresis loop to a material. As a result, the heart of machines makes it easier to choose the correct material for making a permanent magnet.

EVOLUTION OF INTERNET OF THINGS
PAST, PRESENT AND FUTURE

SANKAR S *DURGA S*

Introduction

Internet of Things (IoT) is the networking of physical objects that contain electronics embedded within their architecture in order to communicate and sense interactions Amongst each other or with respect to the external environment. In the upcoming years, IoT-base technology will offer advanced levels of services and practically change the way people lead their daily lives.

Internet of things (IoT) is an ecosystem of connected devices that exchanges data over a wired or wireless network. These devices could be smartphones, laptops, smart electric appliances, smart office equipment or any device tagged with sensors. Data generated by these devices is then shared with servers located in cloud or on-premise, where it is processed to gain insights that help in taking decisions. The IoT ecosystem can be established not only within small areas like our homes or office but over larger areas like gated communities, university campus and cities.

Smart devices that connect with each other are ubiquitous part of our lives. As an individual user or business owner providing IoT related products and services, it makes sense to understand evolution of IoT. Knowledge of past equips us to foresee the future and use any technology to our advantage.

Milestones in IoT Evolution

A child grows every day and amazes their parents every moment, but still there are some moments that become milestones in their life history. Let us attempt to chronicle such milestone moments in the evolution of IoT: -

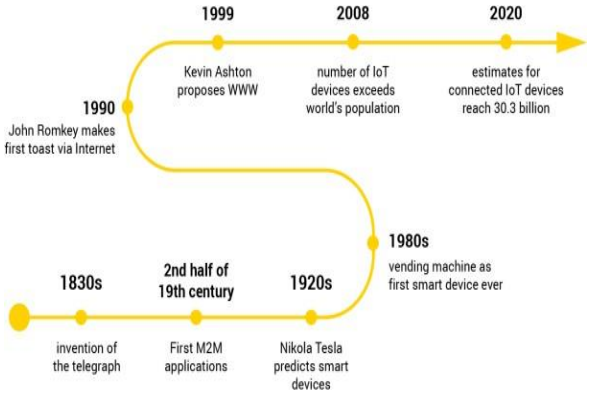
In **1982**, a graduate student in Carnegie Mellon University's computer science department, David Nichols, wanted to know if the department's coke vending machine had cold soda bottles. Hewas tired of going to the machineonly to find there was no cold bottle available; the vending machine was quite some distance from his classrooms. So, he wanted to have information beforehand.

In **1989** Tim Berners Lee proposed the framework of world wide web, which laid the foundation of the Internet.

In **1990** John Romney developed a toaster that could be turned on and off over the Internet. It was a toaster wired to the computer as there was no Wi-Fi then!! This toaster is considered to be the first IoT device – the first "thing" that began Internet of Things.Researchers and scientists seem to have a thing for caffeine – cold or hot.

In **1993**, the Trojan Room Coffee Pot was built in the computer laboratory of the University of Cambridge by Quentin Stafford-Fraser and Paul Radetzky in 1993. An image of the interior of the pot was uploaded to the building server thrice

every minute. Later on, when browsers began displaying images, these images could be viewed



online.

The next milestone in development of Io T came in **1999** when Kevin Ashton, current Executive Director of the Auto-ID Labs, coined the term internet of things. It was the title of a presentation he made at Procter and Gamble (where he was working at that point of time)about linking RFID in P&G's supply chain to the Internet. The term IoT began to be used in mainstream publications like The Guardian and Scientific American by **2003-2004**. In the same period RFID deployed by the US department of Defense and by Walmart in its stores.

The United Nations International Telecommunications Union acknowledged the impact of IoT in its report in 2005. It predicted that IoT will help create an entirely new dynamic network of networks.

In March **2008**, the first IoT conference was held at Zurich. It brought together researchers and practitioners from both academia and industry to facilitate sharing of knowledge. In the same year, the US National Intelligence Council included internet of things as one of the six disruptive civil technologies.

In its **2011** white paper, Cisco Internet Business Solutions Group (CIBSG) said that internet of things can truly be said to be born between 2008 and 2009 when the number of things connected to the internet exceeded the number of people connected to it. CIBSG calculated that the things to people ratio grew from approximately 0.8 in 2003 to 1.84 in 2010.

Together with the white paper, Cisco released many educational materials on the topic and started marketing initiatives to attract clientslooking to adopt IoT. IBM and Ericsson joined the race soon after. In 2011 Gartner included IoT in its Hype cycle for emerging technologies that were on the rise.

In **2013** IDC released a report that predicted IoT market to grow at a CAGR of 7.9% and reach USD 8.9 trillion by 2020.

Economic Impact of IoT

According to McKinsey, the economic value of IoT could be anywhere between USD 3.9 trillion to 11.2 trillion by 2025. This does not seem a very far-fetched estimate considering that IoT is being used in manufacturing, healthcare, automotive, public safety, logistics, energy management, organizational redesign, etc.

The list of types industries and businesses using IoT is really long and the COVID-19 pandemic has forced rapid adoption because it holds the promise of enabling businesses to pivot in the new normal

Challenges in IoT adoption

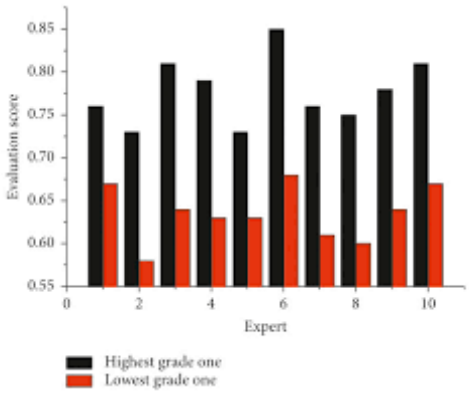
Although IoT promises to transform the way businesses operate, there are multiple challenges in adoption that need to be overcome.

Privacy and security

Data security and privacy of people associated with the IoT system is an area of concern and something that businesses need to take care of since the Inception of any IoT project.

Sustainability

All IoT devices need to be powered on 24/7. This requires huge amounts of energy. Sustainability and environmental impact of IoT adoption must also be considered during project planning phase.



Future of IoT

According to Statista, the total number of installed connected devices is expected to be 75 .4 billion globally by 2025. This would be five times increase since 2015.

These numbers indicate that the future of IoT promises to be more innovative and revolutionary as compared to the present. That more and more domains would be embracing IoT is a foregone conclusion. Let's discuss some of the trends that will change the face of IoT:

5G integration

2020 has already seen testing of 5G by many companies. IoT architecture will be integrating 5G into systems, new as well as old. 5G would enhance capabilities of existing networks manifolds. 5G would not be replacing the existing network but enhancing its capabilities. Old or new, 5G would be enable transmission of data to and from cloud servers at lightning speed.

Single interface

As discussed earlier, more and more devices with varieties of capabilities are joining the IoT networks every second. users — individuals or Enterprises — would need a single interface that provides them end to end access instead of a basket of remotes and interfaces.

Multi-level privacy and security

Data privacy and security is going to be even more important. Historically data security has been implemented at device level be it a smartphone or a laptop or a any other smart device connected to the IoT network. However, in future privacy and security measures would be implemented at multiple layers between IoT endpoints.

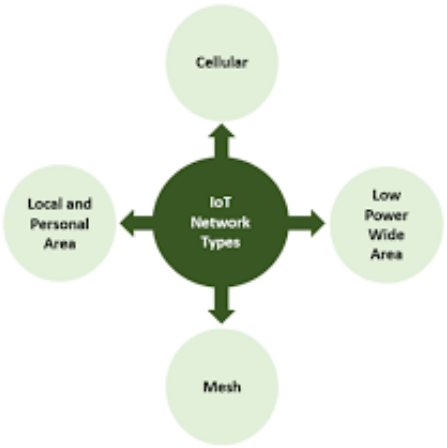
Shift from products to services ecosystem

The key driver of any IoT system is the data generated by it. Companies providing products would gradually move towards services around insights provided by the data.

Role of Tec Ahead in IoT Landscape

Tec Ahead has a team of IoT experts who have developed a wide range of customized solutions from ambient environment and smart lighting to

connected healthcare apps. Some of the services provided by our experts include:



IoT consultancy

Our IoT experts provide a range of specialized consultancy from maturity assessment and Internet of Things (IoT) road map designing to device selection and architecture development. Our experts have hands on experience in full stack development.

Product design

Our experts produce innovative IoT designs that are functional, reliable, robust scalable and Secure and cost effective. They design fully optimized IoT products for Agile development, easy testing and troubleshooting, and predictive maintenance.

1. **Mobile app development**

Mobiles are the most common interface used to control IoT devices. Our mobile app development team applies robust mobile development frameworks to craft powerful, engaging, easy to use, secure and adaptive mobile IoT apps.

2. **IoT dashboards**

The most important business case for any IoT ecosystem is utilizing the data to gain insights. We at Tec Ahead develop IoT dashboards that enable configuration, control and monitoring of end-to-end IoT system. The dashboards also provide role-based data visualization solutions and BI tools to analyze real time data.

3. **IoT Testing**

Our product development team follows rigorous QA and testing procedures so that the product released to your customers is its best version.

Conclusion

A modern IoT system has three layers — physical layer, edge computing layer and application layer. The physical layer collects data. The edge computing layer processes it and prepares it for transmitting to the cloud servers. Application layer consists of applications that provide useful insights using the data. According to McKinsey, the economic value of IoT is expected to be USD 11.2 trillion by 2025. Although IoT is being adopted by a variety of industries and businesses, there are multiple challenges in its adoption. Data is the key driver of any IoT system. Collecting only the required data is essential so that the business is not swamped by too much data. And then the data collected must be stored and transmitted in a secure way so that neither the users nor the IoT devices are compromised. In the coming decade, as more and more data are generated by the IoT systems, product companies would shift towards a services ecosystem. The team of IoT

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ELECTRIC CARS: TECHNICAL CHARACTERISTICS AND ENVIRONMENTAL IMPACTS

TAMILARASAN K, *RAGUL P*

Introduction

During recent years, deep learning has become somewhat of a buzzword in the tech community. We always seem to hear about it in news regarding AI, and yet most people don't actually know what it is! In this article, I'll be demystifying the buzzword that is deep learning, and providing an intuition of how it works.

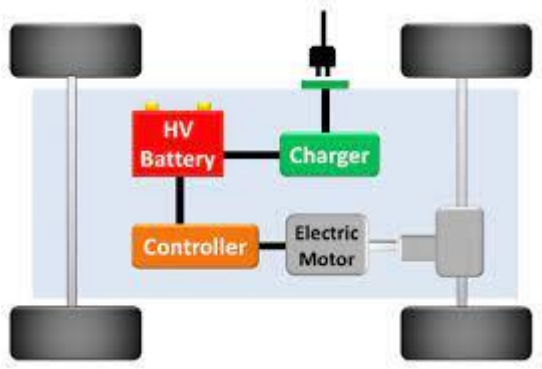
Electric vehicles have been identified as being a key technology in reducing future emissions and energy consumption in the mobility sector. The focus of this article is to review and assess the energy efficiency and the environmental impact of battery electric cars (BEV), which is the only technical alternative on the market available today to vehicles with internal combustion engine (ICEV). Electricity onboard a car can be provided either by a battery or a fuel cell (FCV). The technical structure of BEV is described, clarifying that it is relatively simple compared to ICEV. Following that, ICEV can be 'e- converted' by experienced personnel. Such an e-conversion project generated reality close data reported here. Results: Practicability of today's BEV is discussed, revealing that particularly small-size BEVs are useful. This article reports on an e-conversion of a used Smart. Measurements on this car, prior and after conversion, confirmed a fourfold energy efficiency advantage of BEV over ICEV, as supposed in literature. Preliminary energy efficiency data of FCV are reviewed being only slightly lower compared to BEV. However, well-to-wheel efficiency suffers from 47% to 63% energy loss during hydrogen production. With respect to energy efficiency, BEVs are found to represent the only alternative to ICEV.

This, however, is only true if the electricity is provided by very efficient power plants or better by renewable energy production. Literature data on energy consumption and greenhouse gas (GHG) emission by ICEV compared to BEV suffer from a 25% underestimation of ICEV-standardized driving cycle numbers in relation to street conditions so far. Literature data available for BEV, on the other hand, were mostly modeled and based on relatively heavy BEV as well as driving conditions, which do not represent the most useful field of BEV operation. Literature data have been compared with measurements based on the converted Smart, revealing a distinct GHG emissions advantage due to the German electricity net conditions, which can be considerably extended by charging electricity from renewable sources. Life cycle carbon footprint of BEV is reviewed based on literature data with emphasis on lithium-ion batteries. Battery life cycle assessment (LCA) data available in literature, so far, vary significantly by a factor of up to 5.6 depending on LCA

methodology approach, but also with respect to the battery chemistry

Concepts of electric cars

At the beginning of the automobile's history, two main competing approaches to engine-driven vehicles existed: one with internal combustion engine (ICE) and another one with an electric drivetrain.



Already in 1834, the American inventor Thomas Davenport built the first electric car. The first ICEV was developed in 1886 by Benz and Daimler in Germany. Around the year 1900, electric cars had a significant share of all engine driven cars. At the same time, F.Porsche already invented a hybrid electric car equipped with an ICE range extender and wheel hub electric engines. The two different drive trains were competing until Henry Ford, in 1908, chose an ICEV for the first mass production of a car in history. This way, ICEV won the race early in the twentieth century and displaced the battery electric vehicles (BEV). From an environmental perspective, this may have been one of the biggest mistakes in the history of technology. Concluding, the BEV does not represent recent 'high tech', but a comparatively simple technical concept, meanwhile available as a series product for more than 110 years. Accordingly, e-conversion, which is the con version of new or used ICEV to electric cars, can easily be implemented by experienced personnel. In contrast, the modern lithium- ion battery technology, prerequisite for the everyday life practicability of most BEV, is related to very recent technical improvements.

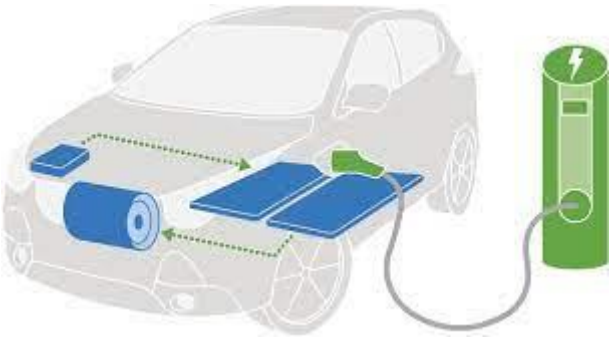
Batteries for electric cars

It is still possible and useful to equip electric vehicles with lead-acid batteries. Cars of the Californian interim electric vehicle boom in the 1990s were partly driven by lead batteries, nevertheless already offering a driving performance comparable to ICE cars. Today, for example, there are small electric trucks commercially available and equipped with lead batteries and a capacity of 13 to 26 kWh, allowing a maximum range of up to 200 km and a maximum speed of 60 km/h (numbers taken from a useful to keep Pb traction batteries for certain applications. Electric cars for smaller ranges, as e.g., in-town driving, so called neighborhood electric vehicles, will be much cheaper if they are operated with lead-acid batteries instead of a lithium-ion battery. Additionally, there are recent performance improvements of the lead battery, thanks to a gel matrix and gassing charge.

However, the enormous increase in energy density offered by Li-ion batteries is the prerequisite for the expected widespread electrification of cars. Nickel metal hydride batteries were used in the interim time when the re-electrification of the automobile started in the 1990s. However, they do not offer enough power and have a worse environmental

impact compared to Li-ion batteries (see below). The only alternative to Li-ion batteries with comparable power, the Zebra cell, is based on molten salt and, thus, only useful for continuous everyday use. Today, a lot of different Li chemistries are available, and prices are continuously decreasing for Li ion batteries.

However, the price for a complete Li-ion cell set offering 14 kWh cap acity, allowing a 100-km electrical range of a small-size car (like a Smart, see below), is still in the order of 5,000 Euro including taxes. Life cycle impacts of the various Li-ion chemistries differ significantly



Technical components of an electric car

According to Larminie and Lowry, the main components of a BEV can be divided into the electric battery, the electric motor, and a motor controller. The technical structure of a BEV is simpler compared to ICEV since no starting, exhaust or lubrication system, mostly no gearbox, and sometimes, not even a cooling system are needed.

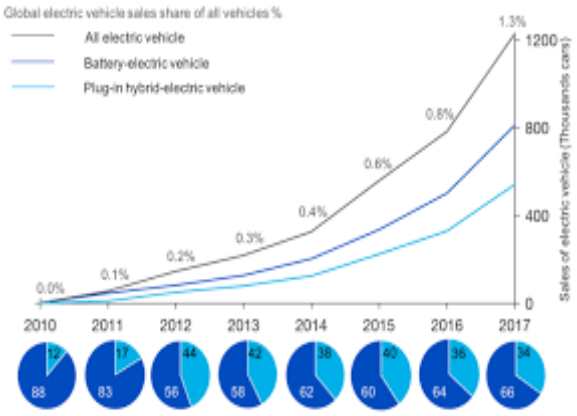
The battery charges with electricity either when plugged in the electricity grid via a charging device or during braking through recuperation. The charger is a crucial component since its efficiency can vary today between 60% and 97%, wasting 3% to 40% of the grid energy as heat. The motor controller supplies the electric motor with variable power depending on the load situation.

The electric motor converts the electric energy into mechanical energy and, when used within a drive train, to torque. In series BEV produced so far, central engines have been used; however, hub wheel electric engines are also possible and would be available for mass production. Modern, highly efficient electric motors arebased on permanent magnetic materials from which the strongest are alloys containing the rare earth elements (REE)neodymium and samarium, respectively. Usualalloys are both NdFeB and Sm Co magnets. This has caused some concern since REEs are scarce, and their export is controlled by a few countries, mainly by China (Helmers, unpublished work).

However, electric motorsfor BEV do not necessarily contain REE. There are several types of electric motors,usuallydivide into alternating current (AC) and direct current (DC) types. There are both AC and DC electric engines built with and without permanent magnets,

according to individual use In electric cars, traction motors without magnets are quite usual since they are cheaper (Loehr C, personal communication). A subspecies of AC motors are induction motors using no REE.

The Tesla Roadster is equipped with an induction motor without REE, as will be the forthcoming Tesla Model S and the Toyota RAV4EV. In a more detailed view, it can be stated that there are several electric engines available operating without REE magnets: conventional mechanically com mutated DC machines, the asynchronous machines, the load-controlled synchronous machines with electrical ex citation, and the switched reluctance



Life cycle assessment of electric cars

In order to quantify the LCA of electromobility, the impacts of electric vehicle production, maintenance and disposal on the one hand, and the impacts of operation including fuel provision on the other hand are quantified. Impact of road construction, maintenance, and dis posal are neglected here since there are no differences between ICEV and BEV. LCA is usually calculated separately for the glider (or platform = vehicles without engine, trans mission, fuel system, or internal combustion components of any kind), the drivetrain (electric engine and associated compounds, transmission, and charging infrastructure). the battery production, and the maintenance and end- of-life treatment, respectively. Other studies also distinguish subparts like inverters/electronics, the generator, and other components.potential, the non-renewable cumulative energy demand, the acidification potential and, of course, the global warming potential as CO_2-equivalents. However, the global warming potentials of BEV production and use are discussed controversially in science and public, while the other criterions are found in the scientific de bate only. We like to point out some of the critical details within the discussion and add preliminary data from a used car converted from ICE to electric. Environmental impact of electric cars Well-to-wheel efficiency of electric cars Considering the enormous worldwide increase of mobility expected for the future, the reduction of automobile energy delivery of fuel to the vehicle tank. TTW quantifies the performance of the drivetrain. Together, both result in the overall well-to-wheel (WTW) efficiency. The WTW evaluation allows estimation of the overall energy and efficiency of automobiles powered by different propulsion technologies.

Considering the fact that cars (light duty vehicles) are so important for worldwide public and private transport, it is astonishing that there are only two technical alternatives to the established ICEV available in the market: battery electric cars and hydrogen-powered fuel cell cars.

Cars equipped with hydro gen- powered fuel cells, however, are not yet available as series products, but manufacturers like Mercedes Benz and Toyota promised to be close to releasing or have already released a small series of FCV. The main advantage of a FCV compared to a BEV is a much big ger range and quick refilling of the tank. However, the necessary H_2 filling station infrastructure is available nowhere in the world, not regarding some single filling stations in a few city centers allowing regional mobility of hydrogen-powered fuel cell vehicles, which must return daily to the same filling station.

Efficiency units Efficiencies of different propulsion technologies may be expressed either by CO_2 equivalent emissions per course unit (e.g., CO_2/km), by energy units (MJ/km), or by percentages looking at the energy trans formed to motion. Since petrol (in US: gas), diesel, LPG (propane + butane) as well as natural gas (methane) are all hydrocarbons and burn to mainly CO_2 while releasing energy, the consumed energy and the CO_2 emissions are proportional. If WTW data are expressed in energy units or CO_2 emissions, they may allow assessing different technology alternatives at least within the ICE sector. Often, these data include both the fuel chain and the operation of cars . However, comparing WTW data of ICEV with alternative technologies is usually complicated by the lack of data and testing schemes for alternative technologies.

ICEV

Good (realistic) data of one technology compared with bad (unrealistic) data regarding the alternative technology can fundamentally change the results of the efficiency evaluation or, following that, the life cycle assessment (LCA) comparison. We decided to review efficiency percentages of the available propulsion technologies for greater transparency. This way, the wrong impression of higher accuracy than available from the data, as well as erroneous conclusions, is avoided while comparing data of ICEV with alternative technologies

Conclusion

The electric car seems to be a suitable instrument and a sustaining measure towards a more sustainable mobility future since it is four times more energy efficient compared to ICEV. Therefore, it is seen as a milestone towards a ‘Great Transformation. The TTW efficiency advantage of BEV over ICEV, together with the efficiency jump by Li-ion batteries, enable the electrification of the automobile as long as it is moved in regional ranges of up to

100 km per day. However, WTW efficiency of electric cars can reach exemplary figures only when electricity is provided by very efficient power plants and infrastructure, best with renewable energy production. Also, electric cars should be incorporated into a variety of modern mobility concepts.

Program Outcomes (POs)

PO1	**Engineering Knowledge:** Apply the knowledge of mathematics, science, and engineering fundamentals to solve the complex electrical engineering problems.
PO2	**Problem Analysis:** Identify, formulate, review research literature, and analyze complex Electrical and Electronics Engineering problems enabling attainment of conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3	**Design/Development of Solutions:** Design solutions, components or process for complex Electrical Engineering problems to meet the specified needs considering public health, safety and environmental considerations.
PO4	**Conduct Investigations of complex problems:** Exercise research knowledge and technical methodology for design, analysis and interpretation of data to converge to a suitable solution.
PO5	**Modern Tool Usage**: Use modern engineering tools, softwares and equipments to predict, analyze and model engineering problems.
PO6	**The Engineer & Society:** Apply reasoning skills to assess societal, health, safety, legal and cultural issues relevant to the professional engineering practice and take consequent responsibilities in the society
PO7	**Environment and Sustainability:** Realize the impact of the professional engineering solutions and demonstrate the knowledge for sustainable development in environmental context
PO8	**Ethics:** Apply and realize the professional ethics and responsibilities in Electrical engineering practice.
PO9	**Individual and Team Work:** Exhibit Individuality, Leadership and Team spirit in multidisciplinary settings.
PO10	**Communication:** Communicate, comprehend, write reports, design documentation and presentation effectively on complex engineering activities
PO11	**Project Management & Finance:** Demonstrate the Electrical engineering and management principles adhering to financial strategies to manage projects as a member or leader in a team
PO12	**Life Long Learning:** Inculcate independent and life-long learning in the broadest context of technological change.

Program Specific Outcomes (PSOs)

PSO 1: Electrical drives and control: Graduates will Analyze, design and provide Engineering solutions in the field of Power Electronics and Drives

PSO 2: Embedded system: Graduates will Simulate, experiment and solve complex problems in Embedded System.

KSR INSTITUTE FOR ENGINEERING AND TECHNOLOGY

VISION

To become a globally recognized Institution in Engineering Education, Research and Entrepreneurship.

MISSION

- Accomplish quality education through improved teaching learning process.
- Enrich technical skills with state of the art laboratories and facilities.
- Enhance research and entrepreneurship activities to meet the industrial and societal needs.

Department of EEE

VISION

To produce world class Electrical and Electronics Technocrats and Entrepreneurs with social responsibilities.

MISSION

- Impart quality education in the field of Electrical and Electronics Engineering through state of the art learning ambience.
- Enrich interdisciplinary skills and promote research through continuous learning.
- Enhance professional ethics, entrepreneurship skills and social responsibilities to serve the nation.

BEES Magazine

August 2021