## DEPARTMENT OF ELECTRICAL & ELECTRONICS ENGG.

# Publication of Student's Article in Technical Magazine

# **“Solar Tracking System Using Microcontroller”**

A renewable resource is a resource that can be repeatedly used and yet be recovered from natural sources that are present in our solar system. Since the solar energy is available in abundance, if we make proper and efficient use of it, we will be able to solve the crisis of the reduction in fossil fuels. In order to maximize power output from solar panels, the panels must be aligned with the sun. To do so a system that tracks the sun is required. But having a stationary solar panel might not be the most efficient way for conversion of solar energy into electrical energy. By using panels that can be rotated along an axis, with respect to the position of the sun. The main component of the solar tracker is micro-controller which is to be programmed to track the sunlight and to make sure that the solar panel is made to receive a great volume of sunlight.

Solar energy is radiant light and heat from the Sun that is harnessed using a range of ever-evolving technologies such as solar heaters, photovoltaic cells, solar pumping, solar architecture, solar power plants and artificial photosynthesis. It is an exceptional source of renewable energy which has been gaining a lot of importance in the recent times due to the shortage of other non-renewable sources of energy. One of the most common technologies that is used for conversion of solar energy into solar power is nothing but the solar panels. Although, huge solar panels have been planted and a huge amount of money is being spent on it, the complete utilization of the panels is not being made due to its immobility. The solar trackers increases power output in solar tracking devices when compared to stationary solar panels. Therefore, the designing should be done in such a way that the solar panel is perpendicular to the rays of the sun at every point of the day to receive a maximum amount of solar energy. The designing and implementation of mobile solar panels that is efficient enough to receive a majority of the sun rays and convert it effectively into solar power or electricity. The sun’s inclination with respect to the earth, the revolution of the earth, as this will lead to the changes in the length of the days and nights and the angle at which the panel is with respect to the sun’s rays at every point of the day. The tracking device consist of solar panel, micro-controller, light dependent resistors, servomotor.

**Mr. Suraj Patil(8th Sem)**

## “Non Isolated DC-DC Converter for Renewable Based Grid Application” :

A high voltage gain dc-dc converter with improved efficiency is proposed in this article for Photovoltaic (PV) based grid application. This converter topology provides high voltage gain with fewer components. The efficient power conversion is achieved with reduced voltage stress across the semiconductor devices. The working principle and analysis of the converter is described in this article. The converter design is made for 250 W power rating and connected to the grid through an inverter. Performance of the proposed converter can be simulated and analyzed using MATLAB/Simulink.

The clean energy source based power generation to meet the grid power demand is a tremendous growing sector in the world. Due to that many researchers are focusing on this area for improvement of alternative energy technologies such as photovoltaic (PV), wind energy, and fuel cells. However, the characteristics of these renewable energies are having low output voltage, and required high step up voltage gain demand by using dc-dc converter, for any potential real time applications. Some requirements are necessary for converter based applications such as low inrush current, reduced switching stress, low weight and volume. The dc-dc converter is divided into two types namely, isolated and non-isolated based converters. The transformer based converters like fly back, push pull, and forward converters. The main drawback of these isolated converters is its dependency on the turns ratio of the transformer for step up process. It also affect the main switch with high voltage spike and power dissipation because the leakage inductor of the transformer. The conventional boost converter cannot generate high voltage gain for applied voltage because of high turns ON resistive issue for semiconductor devices. It also required large duty cycle to produce the high voltage gain for the required application.

**Miss. Anjuma Mulla(8th Sem)**

## "WECS Condition Monitoring And Fault Diagnosis"

Condition based maintenance of WTs encompasses: Service and inspection, measuring and evaluating the actual WT conditions and determining the remaining service life and maintenance. In general, the actual condition of the rotating machinery can be measured and evaluated offline using mobile measurement equipment and online using permanently installed devices. Today it is state-of-the-art for onshore and offshore WTs to be equipped with condition monitoring. The proposed current-based condition monitoring could therefore be easily implemented on the same platform. The objective of this section is to propose a simple and practical approach for an industrial implementation of fault detection and diagnosis.

Compared to steam/hydro/gas turbines used in traditional power plants, wind energy has become a superior renewable energy resource that plays a vital role in the power sector. Wind power is one of the dominating renewable energy resources worldwide. Wind Turbines (WTs) are usually installed in remote areas or offshore in a very harsh environmental condition and, therefore, this makes WTs more prone to failures have relatively higher failure rates. According to some statistical studies, the maximum WT failure rate takes place within the gearbox followed by faults within the power electronic converters. Some of these faults can be catastrophic with significant loss of revenue and they can interrupt businesses that rely mainly on wind energy. To avoid such consequences, the implementation of reliable condition monitoring and fault diagnosis techniques has become essential for all critical components in the electricity grid including the WT. WTs might fail to depend on the either momentary events or aging failures in their components and will lead to system interruptions as well as cause a huge amount of economic losses. The faults in WTs can be classified into two categories: wear-out failures and temporary random faults. Wear-out failures are long-term and permanent events. Repairing or replacing a failed component needs additional costs and results in a loss of energy production. If a failed component is not identified and repaired or replaced in time, it may cause consequent failures of other components and even the entire WT system. Temporary random faults are short-term, temporary events caused by factors such as wind speed fluctuation, thermal issues, grid disturbances, temporary wrong sensor readings, etc. Temporary random faults can usually be cleared by temporarily shutting down and restarting the components with faults or the WTs. Therefore, their impact is primarily a loss of energy production.

Repair actions for a few types of WTs cannot be accomplished due to their extremely high towers. Hence, condition monitoring and fault diagnosis play a significant role in WECS. The main objective is to present a comprehensive review of the state of the art, different types of fault that might occur in WECS, and the diagnosis strategies and related methods.

Condition Monitoring (CM) is a process of monitoring the operating parameters of a physical system. From the change(s) in the parameter(s), possible failure(s) in the system can be diagnosed. A WT condition monitoring system (CMS) provides diagnostic information on the health condition of various WT components and subsystems and, therefore, allows maintenance to be scheduled and taken before a failure or a critical malfunction occurs. The condition monitoring techniques fall into two broad categories: offline condition monitoring and online condition monitoring. Offline condition monitoring requires the WTs to be taken out of service to allow inspection by maintenance personnel. Online condition monitoring offers several advantages over offline condition monitoring. First, online condition monitoring is performed while the WTs are in service. This reduces the loss of energy production and the costs incurred during offline inspection for the WTs. Second, online condition monitoring provides a deeper insight into the conditions of WT components and subsystems during operation and can alert the maintenance personnel to both long-term trends and short-term events that may not be observed with an offline "spot check." Third, online condition monitoring can be integrated into the supervisory control and data acquisition (SCADA) system to automatically trigger appropriate alarms and alert maintenance personnel when a problem occurs. This feature is essential for unattended WT operations, especially in remote or inaccessible locations. Using the information obtained from the condition monitoring process, fault diagnosis can be performed to detect, locate, and identify occurring faults and monitor the development of the faults from defects (incipient faults) into failures; and prognosis can be performed to predict the development of a defect into a failure when the failure occurs, and the remaining useful life of the WT component with the defect. Fault diagnosis and prognosis are important extensions of condition monitoring. Based on the diagnostic and prognostic information, the appropriate (e.g., preventive and optimal) maintenance strategy can be taken to minimize the maintenance cost, reduce WT downtime, and improve WT reliability and lifespan. The majority of the related literature and commercial WT CMS has focused on WT condition monitoring and fault diagnosis (CMFD). Much less work has been reported on WT fault prognosis. Therefore, this survey focuses on WT CMFD.

**Mr. Sumant Jatti (8th Sem)**

# “Speed Control of BLDC Motor Using Fuzzy Logic Controller(FLC)”

Permanent magnet brushless DC motors (PMBLDC) find wide applications in industries due to their high power density and ease of control. These motors are generally controlled using a three phase power semiconductor bridge. For starting and the providing proper commutation sequence to turn on the power devices in the inverter bridge the rotor position sensors required. Based on the rotor position, the power devices are commutated sequentially every 60 degrees. To achieve desired level of performance the motor requires suitable speed controllers. In case of permanent magnet motors, usually speed control is achieved by using fuzzy logic controller.

Fuzzy Logic Controller (FLC) for speed control of a BLDC. The Fuzzy Logic (FL) approach applied to speed control leads to an improved dynamic behavior of the motor drive system and an immune to load perturbations and parameter variations. Fuzzy logic control offers an improvement in the quality of the speed response, compared to PI control. This work focuses on investigation and evaluation of the performance of a permanent magnet brushless DC motor (PMBLDC) drive and Fuzzy logic speed controllers.

Fuzzy logic has rapidly become one of the most successful of today’s technology for developing sophisticated control system. With it aid complex requirement so may be implemented in amazingly simple, easily minted and inexpensive controllers. The past few years have witnessed a rapid growth in number and variety of application of fuzzy logic. The application range from consumer products such as cameras, camcorder ,washing machines and microwave ovens to industrial process control ,medical instrumentation ,and decision support system .many decision-making and problem solving tasks are too complex to be understand quantitatively however, people succeed by using knowledge that is imprecise rather than precise. fuzzy logic is all about the relative importance of precision .fuzzy logic has two different meanings. In a narrow sense, fuzzy logic is a logical system which is an extension of multi valued logic .but in wider sense fuzzy logic is synonymous with the theory of fuzzy sets

Fuzzy Logic control yields superior results with respect to those obtained by conventional control algorithms thus, in industrial electronics the FLC control has become an attractive solution in controlling the electrical motor drives with large parameter variations like machine tools and robots. However, the FL Controllers design and tuning process is often complex because several quantities, such as membership functions, control rules, input and output gains, etc must be adjusted.

**Miss. Rekha A Paraganve(8th Sem)**

## "Battery Technology For Renewables"

The renewable energy sector will see a significant increase in energy density, faster charging capacity, and further cost reductions per unit of energy storage. Renewable energy is limited by non dispatchable output, but improved battery and other storage technology will allow more independence of standalone renewable such as solar energy during the night time.

In addition, with the explosion of electric vehicle demand, the need for improved energy density and faster charging times for long-range transportation is critical. Lithium and cobalt, the essential materials in high capacity batteries, are relatively rare while other more plentiful materials such as silicon, carbon, and sodium ion are being developed as alternatives with higher energy density. These alternatives are not without their problems. Silicon batteries can store over four times the energy, but the battery's capacity rapidly drops. A scientist at the Korea Institute of Science and Technology has used a technique called lithium pre-loading to improve the device's longevity.

Another pressing issue with batteries is charging time. Take for example the Tesla Model 3 car, which needs about one hour on a supercharger for a full charge. There are technologies such as carbon nanotubes that may reduce charging times to less than five minutes. This is a high-demand solution as the transportation and logistics sector electrifies and requires more dispatchable power.

**Mr. Akash Tukare (4th Sem)**

## "Electric Vehicles"

Due to the increase in air pollution, people are changing their mindset towards electrical vehicles. The electrical vehicle industry is rapidly growing and changing day by day. Their market share in the automated industry is also increasing.

Some new exciting models are coming on the market next year. Many manufacturers are investing high in electrical vehicles to grasp all market shares. The next decade should also see a massive increase in the number of Electrical vehicles on the road.

Researchers say that by 2030 it is estimated that somewhere in the order of 125 million should be on the road. But there are some other interesting trends within the EV market to look out for next year. better batteries with high charging capacity, the continued rollout of charging tech, autonomous driving, solar-powered EVs, electric planes, and better software are all things which are going to take place in the coming years. Some students have made the mindset that there is no scope for electric engineering. But, we observe these things there is a high scope for this branch to play an important role in the coming 2021.

**Mr.Hanamant Bhoomar (6th Sem)**

## **“Internet of Things (IoT)”**

The advent of 5G technology, which has speeds 5x faster than its predecessor (4G), has enhanced IoT significantly. The Internet of Things is a collection of “things” connected through the internet, from electronic devices, people, buildings, roads, processes, and even animals — virtually everything we see around.

Typical examples of IoT devices include wearable technology, smartphones, and a variety of sensors.

With the 5G network’s extensive rollout in 2021, a surge in electrical engineering IoT devices is anticipated. In the construction industry, we’ll see smart grids, Visible Light Communication, and Smart Lighting. Further, expanding on the construction industry, electrical contractors will also witness a rise in demand for installing IoT systems in buildings.

This will go yonder to the continuous electrical engineering services for the maintenance and performance monitoring of the IoT systems installed. In other words, electrical engineers who have become well-vested in IoT will enjoy the best paying contracts this year. The intertwining of electrical engineering with IoT means electrical engineers have to adapt to this growing trend.

**Shri. Vivek Mutalik**

## **“Wearable Technologies”**

Wearable devices have become very popular over the past few years. The most talked-about are Apple Watches, which are believed to notify users of vital health conditions such as cardiovascular diseases before they escalate.

But did you know that there is more? In electrical engineering, wearable devices significantly help to improve safety on the job. Electrical engineers can choose from a range of devices that minimize electrical shock risk when dealing with charged circuits.

One example is such a device is “Proxxi.” This device was created to mitigate accidents associated with electrical contact. The manufacturer used two bracelets; when the user gets into proximity with energized equipment, the device notifies the user of the impending danger. The information is automatically sent to a mobile app, which the user can review at any time.

Wearable devices are also being used for access to electrical equipment. They enable operators to communicate, thus replacing mobile phones. Good communication improves safety in the workplace.

**Mr. Akhilesh Patil(6$^{th}$ Sem)**

## "Drones"

The year 2020 saw a massive manifestation of drones. The entertainment industry really could not need more. However, 2021 will see an increasing diversification in the use of drones. Besides shooting fancy Instagram videos or music videos, drones will also be instrumental in the construction industry. When used effectively, they can minimize 5 of every ten accidents that could occur on the worksite.

Electrical engineers are already using drones to scrutinize areas with significant electrical risk before sending a human to work on the problem. Drones are also being used to gather information on a job site before work begins. This helps contractors to analyze the area quickly, hence increasing productivity when the project starts.

**Miss. Vijayalaxmi Walikar(6th Sem)**

## "Energy-Saver Lighting Tech"

A few years ago, LED lamps were super expensive, a situation that forced most people to consider other options. Fortunately, with the recent advances in electrical engineering, that's not the case anymore.

According to reports, energy-saver bulbs consume less than 80% of the energy required by conventional light bulbs. And the best part, today they are also affordable. Energy-saver bulbs save each home an average of 5000-8000 Rs in utility bills annually. With the continuous improvement of this energy-saving technology, LED bulbs are expected to become the standard in 2021 and beyond.

**Miss. Sangeeta H(6th Sem)**

## "Prefabricated products"

The use of prefabricated products is met with varying opinions among electrical engineers. Some are concerned that they threaten their role as engineers. However, prefabricated products may not be as much a threat as they are purported to be. They only help to bridge the gap of labour shortage in the electrical engineering field.

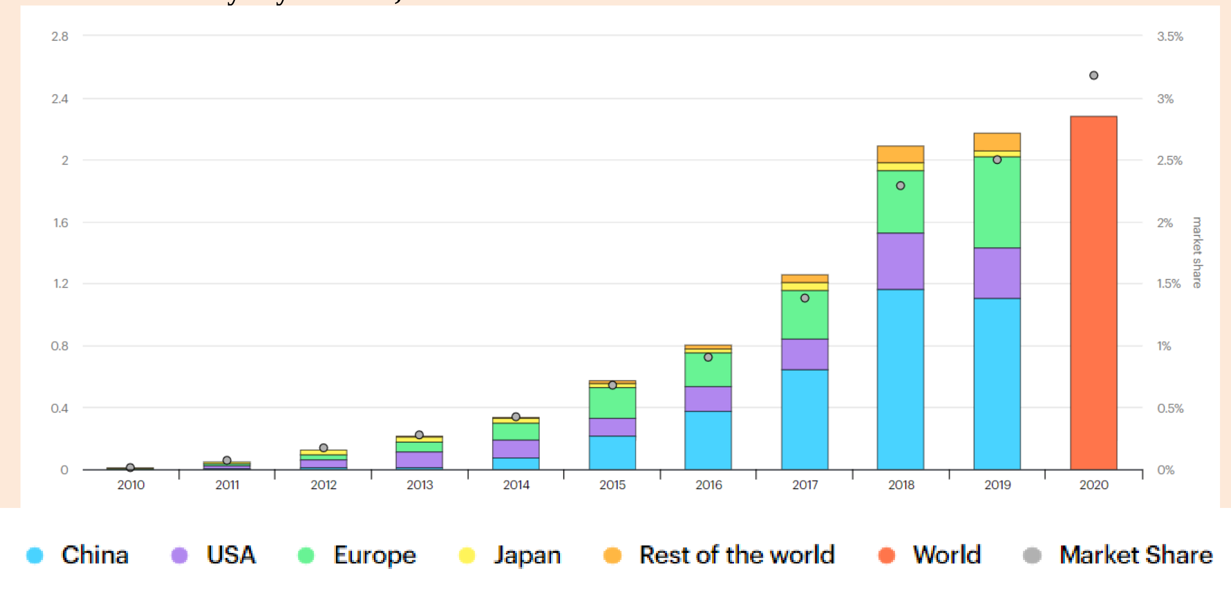
Most electrical engineers prefer to use prefabricated products on big projects that have similar layouts. This significantly saves time, thus allowing the project to be completed early. The engineer won't have to spend too much time on repetitive work that can be done offsite. Another advantage of prefabricated products is that they promote safety on the job site. The engineer will be exposed to fewer hazards. With all these perks, indeed, we are going to see more of them in 2021.

**Miss. Renuka Ganiger(6th Sem)**

# **“New Electrodes May Increase Efficiency Of Electric Vehicles” :**

***A team led by Dr Jodie Lutkenhaus, a professor in the Artie McFerrin Department of Chemical Engineering, believes that lighter electric vehicles can be achieved by storing energy within the structural body panels.*** Washington D.C.: While more and more experts are emphasising over usage of electric vehicles for a sustainable future, there are still several issues standing in the way of its widespread adoption, with researchers working on resolving them. One of the most significant of these challenges has to do with mass, as even the most current electric vehicle batteries and supercapacitors are incredibly heavy. A research team from Texas A and M University College of Engineering is approaching the mass problem from a unique angle. Most of the research aimed at lowering the mass of electric vehicles has focused on increasing the energy density, thus reducing the weight of the battery or supercapacitor itself. However, a team led by Dr Jodie Lutkenhaus, a professor in the Artie McFerrin Department of Chemical Engineering, believes that lighter electric vehicles and aircraft can be achieved by storing energy within the structural body panels. This approach presents its own set of technical challenges, as it requires the development of batteries and supercapacitors with the same sort of mechanical properties as the structural body panels. Specifically, batteries and supercapacitor electrodes are often formed with brittle materials and are not mechanically strong. In an article published in -Matter -the research team described the process of creating new supercapacitor electrodes that have drastically improved mechanical properties. In this work, the research team was able to create very strong and stiff electrodes based on dopamine functionalized graphene and Kevlar nanofibers. Dopamine, which is also a neurotransmitter, is a highly adhesive molecule that mimics the proteins that allow mussels to stick to virtually any surface. The use of dopamine and calcium ions leads to a significant improvement in mechanical performance. In fact, in the article, researchers report supercapacitor electrodes with the highest, to date, multifunctional efficiency (a metric that evaluates a multifunctional material based on both mechanical and electrochemical performance) for graphene-based electrodes. This research leads to an entirely new family of structural electrodes, which opens the door to the development of lighter electric vehicles and aircraft. While this work mostly focused on supercapacitors, Lutkenhaus hopes to translate the research into creating sturdy, stiff batteries.

**Global electric car sales by key markets, 2010-2020**




**Prof. Pramod Murari**

# **“How electric vehicles will shape the future of driving??”**

Electric vehicles represent a rapidly growing, although still small, share of the auto market. As prices drop, battery quality improves and charging stations multiply, industry experts believe EVs could represent more than half the market within 10 years. (contributed)

Predictors of future auto and energy forecasts say that by the end of this new decade, electric vehicles (EVs) could account for half of auto sales in the world. The trends that could lead to those projections include better battery technology and a rising interest in energy efficiency for buses, rideshare vehicles and electric scooters. EV sales jumped an incredible 75% from 2017 to 2018, according to the Alliance of Auto Manufacturers, but by the end of 2018, EVs still accounted for less than 2% of the overall vehicle market.

But auto companies see those small numbers as an opportunity for growth. Around the world, they are investing $225 billion over the next three years to develop more EVs. Manufacturers are offering more than 40 models of EVs, a number expected to grow to more than 200 over the next two years. An analysis by the J.P. Morgan investment firm sees traditional internal combustion engine vehicles falling from a 70% share of the market in 2025 to just 40% by 2030.

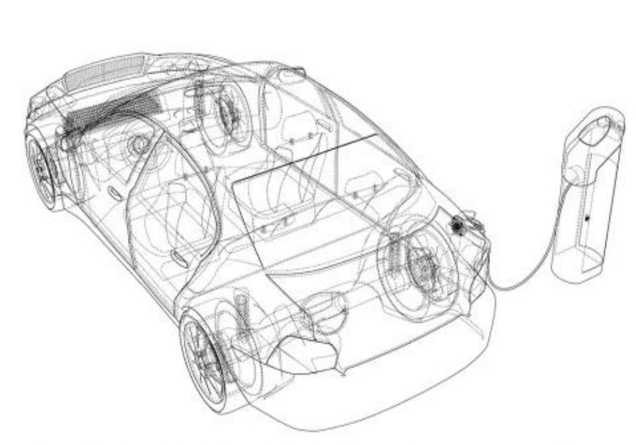
## The efficiency of electricity:

The number of EV charging stations in the U.S. has increased from 16,000 to 22,000 in the past two years. (contributed)

What’s powering those predictions is the worldwide interest in less pollution, higher efficiency and greater economy. A study by the American Council for an Energy Efficient Economy (ACEEE) concludes that electricity produces less greenhouse gases than other forms of energy, especially with the increasing use of renewable power sources to generate electricity. The ACEEE study cites transportation as a sector of the economy that could produce the biggest gains in energy efficiency, mainly because of a shift toward EVs. The study says, “Electric vehicles are generally more efficient and have lower emissions than gasoline or diesel internal-combustion engine vehicles. Thus, operating costs are typically lower for electric vehicles.” While efficiency and environmental concerns provide reasons for EV growth, it helps that they’re getting cheaper. A lot cheaper. One of the biggest costs of an EV is the battery, and fierce competition is driving down prices. The incentives for researchers and manufacturers to lower costs have reduced battery prices about 15% a year for the past 20 years. As a result, the cost of the battery has dropped from more than half the cost of an EV four years ago to one-third today, and is expected to be down to about one-fifth the cost of the EV by 2025, according to the research firm Bloomberg NEF.

## Electric buses, scooters and ride sharing:

As battery prices drop, they get better. In the case of a battery, better means they last longer, which addresses one of the biggest roadblocks to more people buying EVs. There’s a term for the concern that an EV battery will run out before you’re done driving for the day: range anxiety. But batteries can now provide a range of 200 miles before needing a recharge, well above the 40 miles a day that most people drive, even in rural areas.



Heated competition has greatly reduced prices for electric vehicle batteries while also producing batteries that last longer before they need charging. (contributed)

Which brings up another roadblock to EVs – how you charge them. One easy place to charge an EV would be in your garage overnight. There are different ways to charge your car, from a standard outlet, which takes longer, to higher-voltage techniques that might require an upgrade.

Charging stations around the country are another factor people will want available before buying an EV. That number is growing as well. The Department of Energy reports that in the past two years the number of EV charging stations in the U.S. has increased from 16,000 to 22,000.

Experts expect some of the strongest growth in electric transportation to come in specialized uses that could expand to wider acceptance. Bloomberg said that by 2040, 81% of municipal bus sales will be electric. Ridesharing services like Lyft and Uber are another expected market increase. More than a billion people around the world use ridesharing services and the stop-and-go nature of rideshare driving could make the greater efficiency of EVs attractive to those drivers.

New technology also brings unexpected uses. One industry writer says a new electric scooter with a range of 75 miles and a top speed of 15 mph could change what we think of as being a vehicle.

As the Bloomberg study concludes, “Electrification will still take time because the global fleet changes over slowly, but once it gets rolling in the 2020s, it starts to spread to many other areas of road transport. We see a real possibility that global sales of conventional passenger cars have already passed their peak.”

**Mr. Akhilesh Patil ($4^{th}$ sem)**

# **“A Plug In Hybrid Electric Vehicle (PHEV)”**

A plug in hybrid electric vehicle (PHEV) is a hybrid electric vehicle with the ability to recharge its energy storage with electricity from an off-board power source such as a grid. PHEVs have the potential to displace a significant amount of fuel in the next 10 to 20 years. It is estimated that they can reduce fuel consumption by up to 45% relative to that of a comparable combustion engine vehicle. However, the PHEV technique is still expensive compared to techniques which improve internal combustion engines, and additional infrastructure investments are needed for the recharging infrastructure. Moreover, the lifespan of the batteries has not been established, yet, for these types of vehicles. The PHEV can run either on its Internal Combustion Engine (ICE) or on its battery.

A full electric vehicle uses its energy far more efficiently than a vehicle with an Internal Combustion Engine (ICE) and can drive about 2.5 times further with the same energy. For this reason it is expected that the electric vehicle will replace the ICE vehicle in the long run. However, in the coming 20 years or so vehicles will probably still be equipped with IC engines, possibly in combination with electric engines, because per unit of weight an ICE vehicle can still drive about 40 times further. In this 20 year period the IC engine is expected to improve substantially.

The key advantage of PHEV technology relative to full Electric Vehicles (EV) is the fuel flexibility. PHEVs have no limitation of the driving range and if the recharging infrastructure is spatially or temporally unavailable, it doesn’t restrict the use of the vehicle. A possible drawback of the PHEV is that it contains two systems to propel the vehicle, making it more costly to build than EV. However, the car manufacturing industry expects that PHEVs will be introduced to the market first, and that the switch to EV could be made when the PHEVs are found to be economically and technological viable. To enlarge the market share of EVs and PHEVs, safety and reliability are the top concerns of users. However, both of them are subject to not only the battery technology but also the management system for the battery. Therefore, a battery management system (BMS), as the connector between the battery and the vehicle, plays a vital role in improving battery performance and optimizing vehicle operation in a safe and reliable manner. In view of the rapid growth of the EV and PHEV market, it is urgent to develop a comprehensive and mature BMS. Similar to the engine management system in a gasoline car, a gauge meter should be provided by the BMS in EVs and PHEVs. BMS indicators should show the state of the safety, usage, performance, and longevity of the battery. Due to volatility, flammability and entropy changes, a lithium-ion battery could ignite if overcharged. This is a serious problem, especially in EV and PHEV applications, because an explosion could cause a fatal accident. Moreover, over-discharge causes reduced cell capacity due to irreversible chemical reactions. Therefore, a BMS needs to monitor and control the battery based on the safety circuitry incorporated within the battery packs. Whenever any abnormal conditions, such as over-voltage or overheating, are detected, the BMS should notify the user and execute the preset correction procedure. In addition to these functions, the BMS also monitors the system temperature to provide a better power consumption scheme, and communicates with individual components and operators.

**Miss. Shambhavi Patil ($8^{th}$ sem)**

# "State Of Charge (SOC) Estimation For Electric Vehicles"

Electric vehicle batteries are the most important device in electric vehicles. Battery performance and the battery safety are main parameters in electric vehicle and those should carefully analyze. In electric vehicles, customer safety is required most (Yuan, Wu, and Yin, 2013).

Battery performance is generally rely on the chemical reactions happen inside the battery (Cheng et al., 2011). Volatility, flammability and entropy changes cause the batteries to ignite or explode. They can cause dangerous accidents and it could cause to decrease in demand of electric vehicle among the society (Yuan, Wu, and Yin, 2013).

So the batteries must protect by extreme temperature, high charging and discharging rates and over or under voltages to maximize the battery safety and the performance (Cheng et al., 2011), (Densmore and Hanif, 2004). A small change in those parameters especially the voltage could reduce the battery health (Densmore and Hanif, 2004).

Battery management system has an enormous opportunity in cell protection and the system safety. To improve the battery performance, safety and reliability on the battery management systems need an accurate parameter to control the cell balancing and protection systems. Sate of Charge is the parameter used by the battery management system to control its sub systems (Yuan, Wu, and Yin, 2013).

State of Charge expressed as SOC can define as the available or the existing capacity of the battery as a percentage of the real or the rated capacity of the battery (Pattipati, Sankavaram, and Pattipati, 2011), (Cheng et al., 2011).

State of Charge provide a vast support to the battery management system to estimate the current status of the battery and help batteries to operate in its safe range by controlling the charging and discharging. State of charge enhance the battery life and gives controlling signals to balance batteries (Cheng et al., 2011). Moreover, state of charge help to estimate the remaining battery use time and the range that can be travelled by the available battery power (Juang et al., 2015).

State of Charge cannot be measured directly. It can only be estimated (Cheng et al., 2011), (Juang et al., 2015). There are various method of estimating State of Charge. Every method has its own advantages and disadvantages. Battery temperature, varying power request and the aging effect are the main challenges in accurate estimation state of charge (Yuan, Wu, and Yin, 2013). So to accurate State of Charge estimation required measurements of battery voltage, charging or discharging current and the battery temperature (Cheng et al., 2011). Battery damage, battery rapid aging, over charging and over discharging of batteries can minimized by State of Charge accurate estimation (Cheng et al., 2011).

According to the (Yuan, Wu, and Yin, 2013) State of Charge estimation can divide into two groups as open-loop models and close-loop models. There are various state of charge estimation methods. Following list shows the most popular state of charge estimation methods used in electric cars.

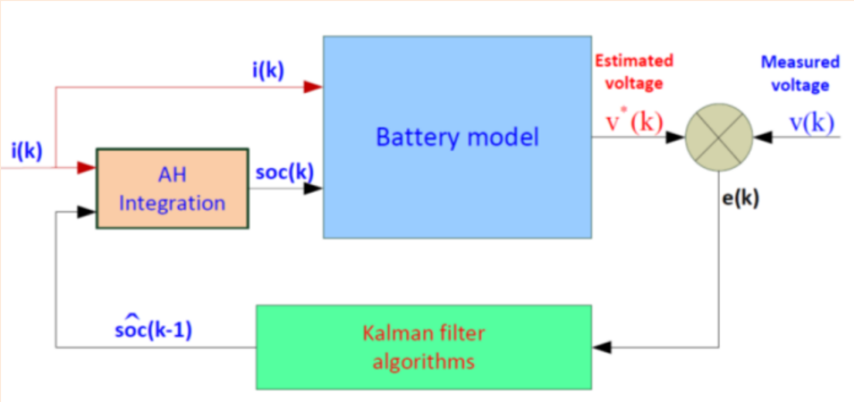
1. Coulomb counting SOC estimation method
2. Fuzzy logic SOC estimation method
3. Impedance spectroscopy SOC estimation method
4. Kalman filtering SOC estimation method
5. Open circuit voltage SOC estimation method

Coulomb counting method is the most used method in battery state of charge estimating. It is first used in lead-acid batteries. That charge estimation method is known as "Peukert's Law" (Juang et al., 2015). In this method, batter's initial charge has to be known for charging and when discharging total battery charge has to be known. Charge is estimated in coulombs (Juang et al., 2015). To estimation of the charge a battery model has to be made. That battery model has variables such as temperature, current dynamics and aging.

Fuzzy logic estimation method used logic based system structure to estimate the State of charge. In the article (Singh et al., 1999) the authors proposed a State of Charge estimation methods using fuzzy logic method with combination of coulomb counting and impedance spectroscopy separately. Digital electronics are most important in fuzzy logic method because it needs digital hardware.

Another method for State of Charge estimation is impedance spectroscopy method. This method is used mostly to estimate lead acid battery charge in the automotive industry. However, this method is now used in electric vehicle technology. For estimate state of charge impedance based method cell resistance is taken as the main parameter (Juang et al., 2015). Impedance spectroscopy method needs a battery model to do its estimation task. A sample electromechanical impedance spectroscopy based battery model is developed in (Zhu et al., 2015) article. Impedance spectroscopy is offline method and it is cost effective (Qahouq, 2016). Typically impedance spectroscopy state of charge measurement is done by injecting a small ac signal into the battery and then analyzing the response. In (Qahouq, 2016) the author proposed a DC/DC converter based impedance spectroscopy strategy that can be operated without injecting ac signals into the battery. The specialty is that is an online method and it fast the estimation.

Kalman filtering method is a online State of Charge estimation method and a closed loop battery model should develop to use this method to estimate state of charge. State of charge value is determine by the voltage error between the estimated voltage from the battery model and the measured voltage value. When the closed loop system is stabilized, the system will provide a voltage reading almost identical to the battery terminal voltage. This method is most relevant so it provide precise safety information about the battery. However this system is complex. Needs a accurate battery model and the computation is also complex (Yuan, Wu, and Yin, 2013).




**Prof. Keshav Negalur**

## "Current Li Ion Battery Technologies In Electrical Vehicles"

Electric vehicles (EVs) were first demonstrated in 1828 with the first production electric car introduced in1884.These EVs had clear advantages over the competing steam- and gasoline-powered vehicles, such as absence of the loud noise from an un-muffled internal combustion engine, and the difficult starting procedures that in early vehicles required the involvement of specialized staff that would initially heat those engines to operating temperature. The desire to decrease the negative ramifications associated with the use of internal.

Combustion engine powered transportation and in particular the drive to decrease carbon emissions has led to a significant resurgence in interest in electrified transportation. Particular importance to enable electrified transportation is the availability of economically and technologically robust batteries.

In 1899, Waldemar Jungner introduced the nickel-cadmium battery that made significant improvements in storage capacity but had some drawbacks including a voltage suppression issue that occurs as the battery aged, known as a memory effect.1985 that the first lithium-ion (Liion) batteries were created. It took a further 6 years of research before they were commercialized. In the meantime, EVs using ZEBRA batteries and Nickel-Metal Hydride batteries were developed. The current predominant battery energy storage technology for EVs is the Li-ion battery.

Batteries are fundamentally a storage medium made up of two electrodes in an electrolyte. This electrolyte provides a medium for the exchange of ions which produces the electricity.

In general, Li-ion batteries can be characterized as energy storage systems that rely on insertion reactions from both electrodes where lithium ions act as the charge carrier. Given this broad definition, there are several different cell chemistries that make up the Li-ion battery family. Most Liion batteries use a negative electrode. principally made from carbon (e.g., graphite) or lithium titanate ($Li4Ti5O12$), with some novel materials under development, namely, Li metal and Li(Si) alloys.

The electrolyte used varies based on the choice of electrode materials, but is typically composed of a mixture of lithium salts (e.g., $LiPF6$) and an organic solvent (e.g., diethyl carbonate) to allow for ion transfer—these components will be discussed in more detail below. A separating membrane is used to allow lithium ions to pass between the electrodes while preventing an internal short circuit.

with the transport aspects of the battery when operating as an energy source (i.e., a galvanic device) illustrated—the electrons travel from the negative electrode to the positive electrode while simultaneously the Li+ ions travel from the negative electrode through the electrolyte to the positive electrode to maintain electroneutrality. When the system is operated in charge mode (i.e., as an electrolytic device) the electron current and Li+ ion flow is reversed.

There are therefore many choices of materials for the positive and negative electrode materials, the electrolyte, and the separator. The technological limitations of the various materials are driven by their function, as detailed. The electrolyte must offer the highest possible lithium ion transport under use conditions.

The batteries must operate in the general environment, likely to extend from, e.g., 30°C for a vehicle that has been parked for a period of time in extreme cold, to +60°C for a battery that has heated as a consequence of the combination of environmental conditions and heat generated by charging. The separator must likewise offer the highest possible lithium ion conduction under the same operational conditions and must offer the ability for a rapid thermal shutdown if significant overheating occurs to prevent a thermal runaway process.

A suitable combination of negative and positive electrode materials must exist that leads to a cost-effective high capacity battery. A summary of battery electrode materials and their electrochemical half cell potentials vs. a $Li/Li^+$ reference can be found.

The eventual cell voltage is the difference between the chosen pair of electrode materials, and further modified by cell losses, such as necessary over potentials to achieve current flows, or IR losses due to poor $Li^+$ ion transport through the electrolyte. For example, if $LiFePO_4$ was chosen as the positive half-cell, and $Li_4Ti_5O_{12}$ as the negative half-cell, the nominal open circuit voltage would be $V_{OC} = V_+ - V_- = 1.95$ V, where $V_+$ represents the half-cell potential of the positive electrode and $V_-$ that of the negative electrode.

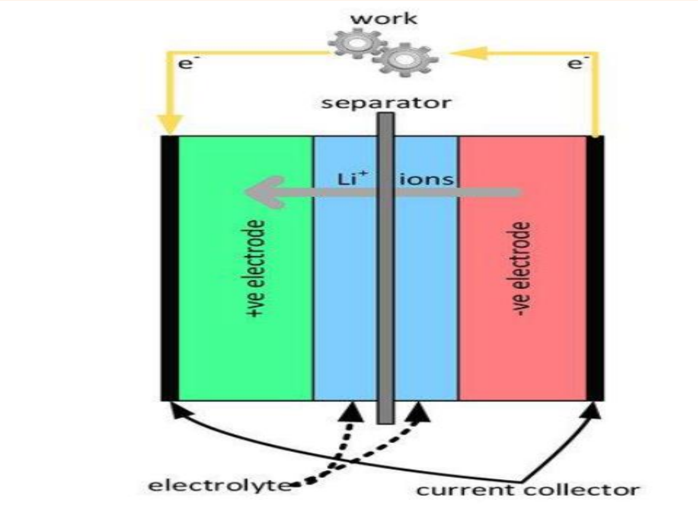


Fig: The schematic construction of a Li ion battery

**Advantages**

1. Smaller and lighter
2. High energy density
3. Low self discharge
4. Quick charging
5. Longer lifespan

**Disadvantages**

1. Expensive
2. Ageing effect
3. Safety concerns
4. Developing technology

**Applications**

1. Cell condition monitoring
2. Charge and discharge control
3. Storage control

**Miss. Akshata Hiremath (8th sem)**

# “High Voltage System Safety For Electric Vehicles”

In electric vehicles, high current and high voltage is a common factor. Their voltage levels are higher than the safe voltage ranges and the also the electric system impedance is small (Zhao et al., 2016). Opiating current of electric vehicles can reached to 300A. Such current is more dangerous to a human body. If such an electrical system short the shorting current is pretty much higher than the maximum operating current (Zhao et al., 2016). So high voltage system design has to be done with a more consideration of the high voltage system and the passenger safety (Zhao et al., 2016).

To avoid high voltage electric shocks to a passenger need a proper isolation between the vehicle chassis and the high voltage and low voltage electrical systems. There should be a 100 ohm per 1 volt isolation resistance in a DC circuit according to ISO6469-3 and 500 ohm per volt in AC (Kota and Balasubramanian, 2013).

High voltage system monitoring include isolation condition monitoring of circuits, electrical system connection condition and high voltage connection condition etc. (Kota and Balasubramanian, 2013). Typical values on a protection circuit according to (Cao and Emadi, 2011) as follows.

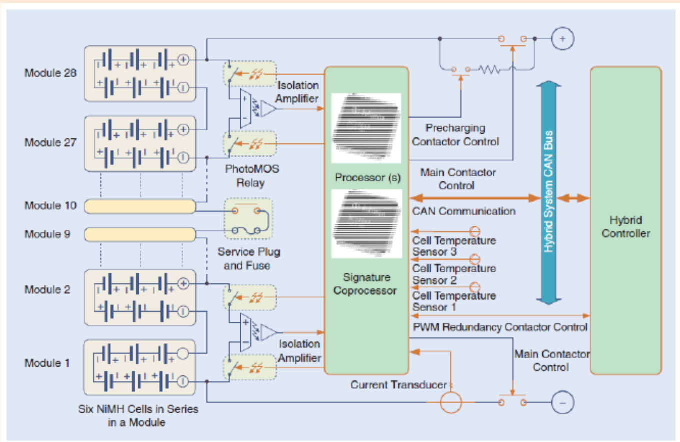
*Typical programing values of protection circuit*

| Protection Item | Typical Programmable Range |
|---|---|
| Overcharging detection voltage | 3.9 – 4.4 V |
| Overcharging release voltage | 3.8 – 4.4 V |
| Over discharging detection voltage | 2.0 – 3.0 V |
| Over discharging release voltage | 2.0 – 3.4 V |
| Discharging overcurrent detection voltage | 0.05 – 0.3 V |
| Load short-circuit detection voltage | 0.5V fixed |
| Charge overcurrent detection voltage | -0.1V fixed |

Between high voltage system and low voltage systems isolation amplifiers or optocouplers are installed to ensure the system safety. The auxiliary battery powers the battery management circuits. Therefore, the system circuit ground and the battery ground is different.

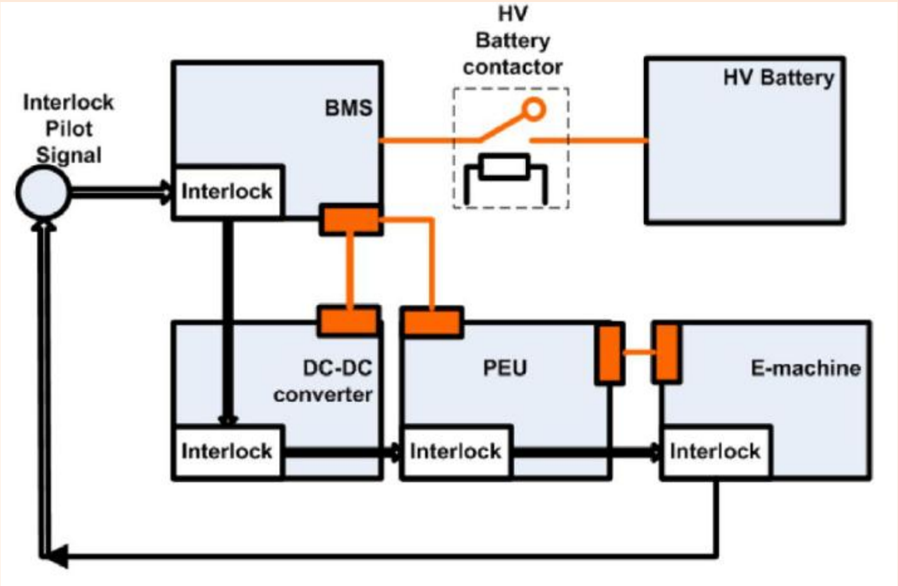
Therefore high current needs to sense. So isolation amplifiers are disconnected by photo-MOS relay when voltage sensing is not done. The following figure shows the isolated cell balancing system of Toyota Prius 2009 version.

*Typical Isolated BMS in electric vehicles*



Moreover, the electric vehicle safety system should include high voltage safety features for connector opening, cover open and for a vehicle crash situation. High voltage interlocks are installed in electric car to cut of the high voltage battery from the system when if a safety issue happen. A typical high voltage interlock system is shown in the above figure.

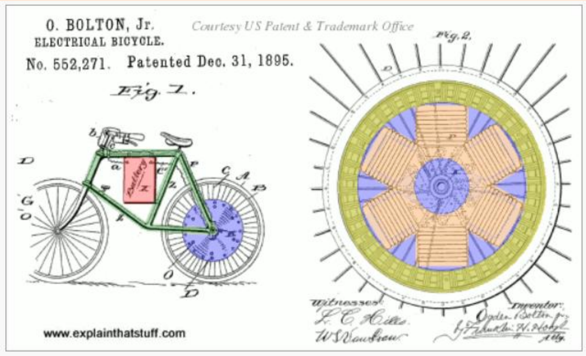
*High Voltage Interlock system*




**Miss. Rajeshwari Baradi (6th sem)**

## "Who invented electric bikes??"

*One of the first electric bicycles. Two artworks from US Patent 552,271: Electrical Bicycle by Ogden Bolton, courtesy of US Patent and Trademark Office.* The oldest patent for an electric bike I've been able to find at the US Patent and Trademark Office is this one, by Ogden Bolton, Jr. of Canton Ohio, which was filed in September 1895 and granted three months later. You can see from these original diagrams that it bears an amazingly close resemblance to modern electric bikes. In the general picture on the left, you can see there's a hub motor on the rear wheel (blue), a battery suspended from the frame (red), and a simple handlebar control to make the thing stop and go. In the more detailed cutaway of the hub motor on the right, you can see there's a six-pole magnet in the center (orange) bolted to the frame and an armature (made from coiled wire, yellow) that rotates around it when the current is switched on. It's quite a hefty motor even by modern standards; Ogdon mentions "a heavy current at low voltage—for instance, to carry one hundred amperes at ten volts." So that's 1000 watts, which is about twice the power of a typical modern bike hub motor.




**Shri. Vivek Mutalik**

# **“The Race for the Best Electric SUV”**

Over recent years, the popularity of electric vehicles has skyrocketed. Greater awareness of environmental issues paired with increased availability of affordable and stylish electric cars has led to them becoming an attractive option. What’s more, the recent announcement that the ban on new petrol and diesel has been brought forward to 2035 gives even more urgency to the production of electric vehicles.

Originally, electric cars were associated with small, streamlined, sporty vehicles. In 2008, Tesla released the Roadster, which lived up to this stereotype. This model was the first all-electric car to use lithium-ion battery cells, and the first to travel 200 miles per charge. Setting an impressive precedent, this marked the dawn of a new age of electric vehicles.

Fast forward to 2016 and Tesla was leading the way again with the first pure electric SUV — the Tesla Model X. Tesla was certainly a trailblazer in this department, but recently, a plethora of options have come to the market, posing fierce competition. In 2019, the Mitsubishi Outlander proved to be the top electric vehicle by fleet size (41,265) The fact that this SUV had out-sold smaller, more traditional electric vehicles, such as the Nissan Leaf, proves the impressive rise of the electric SUV.

We have always loved our SUVs here in the UK, yet with the post-Brexit pollution legislation, the low-emissions limit will be harder than ever to hit. After leaving the EU, our emissions will no longer be set-off by countries such as Italy who tend to favour smaller, more fuel-efficient cars. Therefore, if we want our love-affair with larger SUVs to continue, then we need to look towards the electric SUV market. So, if you’re considering making the switch this year, read on to find out the best electric SUV options on the market today.

**The Luxurious: Audi E-Tron:** If you’re looking for an electric SUV that ticks all of the boxes, and you’re willing to splash out for the car of your dreams, then you’re bound to fall in love with the Audi E-Tron. Setting the standard for 2020, this vehicle lives up to the luxury that Audi promises, with a sleek interior and top of the range touch-screen infotainment system.

This vehicle has an impressive ten-minute charge time and is equipped for every eventuality, including light off-roading. A full charge will allow you to drive for 204 miles.

**The Stylish: Mercedes-Benz EQC:** Silent and sleek, the Mercedes-Benz EQC brings sophisticated quality to the electric SUV market. For lovers of new and used Mercedes alike, this vehicle will satisfy every desire you might have for an electric SUV — silence, efficiency, safety, and style.

Comfort is also at the forefront of this design, and the smoothness of the drive is unrivalled. The battery charge time is 41 hours at 220V, or 0.67 hours at 440V, allowing for ultimate flexibility.

**The Affordable: Hyundai Kona EV:** If price and practicality are high up on your list of priorities, then opt for the Hyundai Kona EV. Fully charged, it will go as far as 258 miles and can get from 0-60 mph in 6.4 seconds — not too shabby considering the relatively low price tag! This vehicle may not have as many high-tech features as the more expensive models on the market, but its impressive design has already earned the title of 2019 North American Utility Vehicle of the Year, so it is clearly doing something right.

**The Hybrid: BMW X5 xDrive45e:** Boasting two extra cylinders, a significant increase in battery capacity (now 24kWh, up from just 9.2kWh), and an overall more economical drive, the BMW X5 xDrive45e is the perfect hybrid option. Many people still don't feel ready to take the plunge into a pure electric drive, but if efficiency and the environment are still at the forefront of your concerns, a hybrid vehicle is the next best thing.

This SUV has an incredibly smooth electric to hybrid switchover, which is hardly more noticeable than a gear change. The upgrade from its previous four-cylinder form has rocketed this hybrid SUV into becoming one of the most highly recommended models.

Whatever your priorities, the electric SUV market has expanded so much in recent years that now there is truly an option for everyone. With the introduction of new Low Emission Zone (LEZ) standards and the post-Brexit pollution legislation, there has never been a better time to invest in an electric vehicle. If space, functionality, and off-road ability are some of your main concerns, make that vehicle an SUV.

**Mr. Sanjeev Dabbanavar (8th sem)**

## "Automated Or Manual Switching Of Fuel Engine To Electric Motor"

A hybrid electric vehicle is one, which uses fuel power and electric power to run vehicle. Sometimes necessity comes in so as to run a vehicle even on exhaustion of fuel, in which the hybrid electric vehicle models fails to satisfy the need. The automated or manual switching of fuel engine to electric motor aims at satisfying such a need. Often, when the fuel level comes to reserve, the driver as no other option than to refuel the vehicle. in such a case, this can be incorporated in vehicle so as to provide an uninterrupted driving by automatic switching from fuel engine to electric drive.

Several economic and environmental factors are contributing to increasing interest in alternative vehicle technologies. These factors include rising global demand for oil, concomitant increases in fuel prices and anthropogenic climate change. Rising global demand for oil has economic consequences. Increasing demand has a direct economic impact via increased commodity prices as well as a number of geopolitical implications that create political challenges for countries that rely on imported oil for economic activity. Moreover, evidence of the increasing dangers posed by climate change adds to the urgency to reduce the greenhouse gas (GHG) emissions from all sources. Hybrid electric vehicle (HEV) technology and its various applications have made significant market gains in recent years and form an important part of the fuel economy equation. Initially only introduced in North American, European and Japanese markets in the mid-1990, HEVs are now starting to gain markets in developing and transitional countries, including China and Brazil.

**Prof. Hemalata R Zinage**

# World's largest solar park launched in Pavagad, Karnataka

The 2,000 MW Park named as 'Shakti Sthala', spans across 13,000 acres spread over five villages and is a benchmark in the unique people's participation in power model put on ground. The world's largest solar park set up at an investment of Rs 16,500 crore at Pavagada in Karnataka's Tumakuru district was launched by Chief Minister Siddaramaiah today. The 2,000 MW park, named as 'Shakti Sthala', spans across 13,000 acres spread over five villages and is a benchmark in the unique people's participation in power model put on ground, according to officials.

The park's development is anchored by the Karnataka Solar Power Development Corp. Ltd (KSPDCL), an entity formed in March 2015 as a joint venture between Karnataka Renewable Energy Development Ltd (KREDL) and Solar Energy Corp. of India (SECI).

The project has been executed within a record time of two years, with zero land acquisition, Siddaramaiah said. Moreover, the farmers who have leased out their land are reaping greater benefits with Rs 21,000 per acre being offered as rental, an amount which has the scope to grow by five per cent every two years, he said. The beneficiaries of this project were 2,300 Pavagada farmers, he said. The chief minister said Karnataka has emerged as the third largest producer of renewable energy in the nation and was taking "bold strides" towards emerging as an energy surplus state. "This ambitious project, spanning five villages, looks at farmers as the key partners, as also beneficiaries. Shakti Sthala is creating new job opportunities and economic growth leading to the prosperity of the people of Pavagada," he said. The state has witnessed an overall increase in capacity to 2,3379 MW as on January 2018.

Collected by: Mr. Kalmesh Rendale, 4th Semester, EEE

Photo: Sila Nanotechnologies

**Sila's Silicon Savior:** These prototype cells, built with a silicon-rich anode material developed by Sila Nanotechnologies, help demonstrate a new approach for boos ng the capacity of lithium-ion ba eries.

Depending on the applica on, use of this anode material will boost ba ery capacity ini ally by about 20 percent and eventually by 40 percent or better. What's more, explains Yushin, it allows the anode to be reduced in thickness by up to 67 percent, which in turn may permit the ba ery to be charged as much as nine mes as fast. And it brings safety bene ts as well, he claims, because it suppresses the forma on of threadlike metallic dendrites, which can cause cells to short out internally and burst into ame.

Yushin says his company's new anode material is composed of particles that are similar in size to the graphite ones being used in anodes now. But they contain silicon inside porous sca olding, which provides room for the silicon to expand and contract without coming into contact with the electrolyte. This allows ba eries made with this silicon-rich anode material to perform well for 400 to 1,000 full charge-discharge cycles, which is more than enough for most applications. "Even for electric cars, you often don't need more than 1,000 cycles," says Yushin.

That helps explain the interest of BMW, which is working with Sila to explore whether lithium-ion ba eries built with the new anode material can be used in its electric cars. Nevertheless, Yushin says "the initial products will be wearable," for which the cost of the battery is not such a critical factor and the amount of anode material required is much more modest, meaning that his company can more easily meet demand. Yushin expects lithium-ion ba eries with Sila anodes will be in millions of devices in 2019.Sila probably won't be the only company to unveil a silicon-ba ery technology this year. Another California company, Enovix, is expected to introduce an anode that is made en rely of silicon and silicon oxides.

Ashok Lahiri, cofounder and chief technology o cer for Enovix, along with two colleagues, described the company's battery technology in detail in these pages in 2017. At the me, Enovix planned to borrow fabrica on techniques from the semiconductor industry to construct batteries from thin wafers of solar-grade silicon. But the company reconsidered that strategy a er grappling with how to apply it to larger lithium-ion batteries for vehicles. "We realized that the solar-grade substrates could not scale," says Lahiri. So Enovix revamped its approach and is now using a metal foil instead of a silicon wafer as the substrate for its ba ery. The overall geometry of the ba ery, however, remains the same. It's just built differently—by stacking components, says Lahiri, who explains that keeping the anode stack under high pressure inhibits the expansion during charge and allows the anode to be made en rely from silicon and silicon oxides.

"We think our battery will be from 30 to 70 percent better, depending on the application," says Lahiri. If so, or if Sila comes through with an anode that can similarly boost capacity by such double digits, it'll really shake up the battery industry, where normally, as Lahiri quips, "people kill for 5 or 10 percent." *Collected by:* ***Miss. Savitri S .HUllannavar***

# BLUE BRAIN

**Student Name:** Surajkhan F Pinjar (2HN15EE048)

Blue Brain is the name of the world's first virtual brain. A Virtual machine is one that can function as, a very appropriate application of an Artificial Intelligence human brain. Reverse engineering is a foremost concept of implementing the human brain and recreates it at the cellular level inside a complete simulation. The four major motivations behind the Blue Brain Technology are treatment of brain disfunctioning, scientific curiosity about consciousness and human mind, a bottom up approach towards building thinking machine and databases of all neuroscientific research results and related past stories. There are three main steps 2 to build the virtual brain are data acquisition, simulation and visualization of results. The mission is undertaking the Blue Brain technology is to gather all existing knowledge of the brain, raise the global research efficiency of reverse engineering and to build a complete theoretical framework.

## Introduction:

The Blue Brain is assumed to be the first one to explore about a true "Artificial Intelligence" via the process of reverse engineering and also the effort to reverse engineering a human brain. The vision behind Virtual Brain will help shed some light on some aspects of human recognition. The Blue Brain Project aims to build a full computer model of a functioning brain to simulate drug treatments or any other brain related problems. Blue gene supercomputer constructed by IBM was a machine first used by Blue Brain Project and then a term Blue Brain was introduced. It can be implemented by using supercomputer, the fastest type but quite expensive and are assist for special tasks which require abundant amount of mathematical computations, like weather forecasting employs a supercomputer. The back pane of Blue Brain is Artificial Intelligence, a technology which builds intelligent machines and imparts intelligent agents. Knowledge, learning, reasoning, planning, communication and perception are the main goals of its research. Computational intelligence, statistical methods and traditional symbolic AI are its main effective approaches.

**MAIN STEPS TO BUILD VIRTUAL BRAIN:**

- **DATA ACQUISITION**
  - In Data Acquisition we need to study different types of neurons
  - Taking the Brain slices and placing them under a microscope measuring the shape and Electrical activity of individual neurons.
  - These observations are translated into mathematical algorithm which describes the form, Function and positioning of neurons.
  - The algorithms are then used to generate biologically realistic virtual neurons ready for Simulation