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From the Editor's Box...

Welcome to *VOLTAFFAIR*, yearly technical magazine of the Department of Electrical Engineering, Technique Polytechnic Institute. *VOLTAFFAIR*, however, is not all our name refers to. The name is, to be sure, a nod to the most distinctive feature of the teachers & students of the department trying to enlighten latest inventions in the field of science.

Far from being just one academic unit among many, the department has long drawn together itself in the college in broad critical thinking about aims and methods of education and leaps in the co-curricular & extra-curricular activities with distinctions.

The department is certainly a centripetal force within the college. More recently it has also acted centrifugally, enabling its students to sites around the state to learn, work and make a difference. Studies for higher qualifications have exploded, making Technique Polytechnic Institute a growing presence beyond the quads, outside the city and in West Bengal.

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SMART DISTRIBUTION ELECTRICAL GRIDS

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1. INTRODUCTION

Smart grid is the future generation power grid system that can intelligently integrate all the devices, consumers and generators associated with it. Intelligent devices are placed throughout the smart grid system, which updates the traditional power grids by automatic and intelligent controlling of grid using digital technology. Now the electrical grid in the entire world is trying to change its visage and trying to commence a new era in the electrical engineering track.

Indian electrical grid system is facing a lot of problems compared to the electrical grid in the developed nations. The major problems faced by the Indian grid system are the wastage of energy, the power theft, the poor detection method for line fault, and the manual controlling and billing system. These problems mainly affect the economic growth thereby social welfare of the country.

The power theft is one of the major problems faced by Indian electrical grid, which makes a big hole in the economic system that is liable for the out flow of a part of the country's wealth. The line fault detection method is also poor in existing grid system such that the administrator did not get the specific position of fault in the transmission line. The smart grid has sensors throughout the grid system so that it can solve these two problems very effectively and efficiently. Manual billing and controlling system of electrical grid lacks efficiency and wastes manual energy. This can be solved by the implementation of a smart grid feature called advanced metering infrastructure.

2. ARCHITECTURE

The single phase secondary distribution system consists of a step down transformer which steps down 11KV to 230V. The phase line is stretched from the transformer to the single phase consumers through the transmission line posts. The electric secondary distribution system is taken as research subject as it is more prone to the problems like wastage of energy by the consumers, the power theft, the poor line fault detection method, and manual billing and controlling system. To solve the above mentioned problems, wireless intelligent devices are placed on the feeder circuit of the transformer, on the top of every line posts, and associated with the electric meters of every consumer. Figure1 shows the schema of the smart distribution system for India.

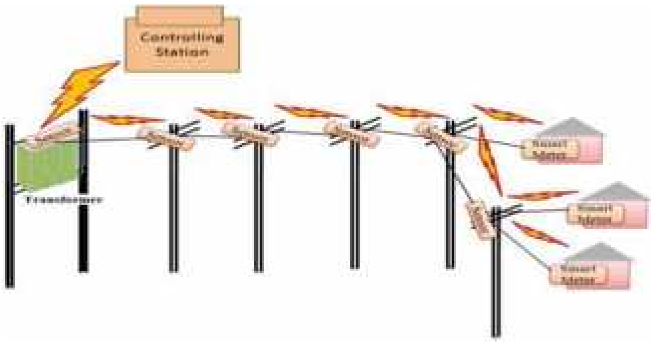

Figure 1. Smart distribution system for India

The smart meters in every home measures the average power and energy consumption and send these parameters to the nearby sensor in the line post. The energy consumption value will propagate through the distribution grid and reaches the controlling station. Thus the controlling station can make bill for each consumer. Thereby automatic billing feature is capable in the electric grid system. Also by measuring the power in one second, it is possible to give warning signal in peak time, if any consumer exceeds their consumption limit. Thus it is possible to decrease the wastage of energy by the consumers.

The line post sensor measures the power by its own and receives the power value from the sensors it directly connected. The line post sensors also do some comparison methods between the measured power value and the summation of the received power value. This enables to detect the correct position of the power theft and line fault in the smart energy distribution system. This smart distribution system efficiently tackles the major problems faced by the Indian grid system.

3. TEST SCENARIO

3.1 Experimentation Setup

The testing scenario consists of three line posts with a phase line and a neutral line passing over these posts. The smart meter module connected to the test setup communicates with the controlling station. The controlling station includes the computer system and the communication module. The smart energy metering circuit transmits the power line parameters to the controlling station. In the controlling station, the received consumption details are recorded in the database for smart grid.

3.2 Admin Visualization and Consumer Visualization

The authority visualization software is developed using the programming language JAVA. It allows the administrative officers to view the changes in the entire electric grid from their offices itself. It shows the electric grid structure with all the nodes. This setup allows the authority to add or delete nodes and it also shows the indications of power theft and line fault in any segment of the transmission line. This avoids the problem associated with the existing inefficient manual billing system. In the smart grid system, the consumer is provided with a unique ID and password. Using these unique details, the consumer can login and view their details.

4. CONCLUSION

The architecture for smart distribution grid is proposed in this work. The test scenario for the proposed architecture will demonstrate how the smart distribution grid architecture solves the major problems faced by the Indian electrical grid.

FLEXIBLE ELECTRONICS

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1. INTRODUCTION

Flexible electronics, also known as *flex circuits*, is a technology for assembling electronic circuits by mounting electronic devices on flexible plastic substrates, such as polyimide, peek or transparent conductive polyester film. Additionally, flex circuits can be screen printed silver circuits on polyester. Flexible electronic assemblies may be manufactured using identical components used for rigid printed circuit boards, allowing the board to conform to a desired shape, or to flex during its use. An alternative approach to flexible electronics suggests various etching techniques to thin down the traditional silicon substrate to few tens of micrometers to gain reasonable flexibility, referred to as flexible silicon (~ 5 mm bending radius).

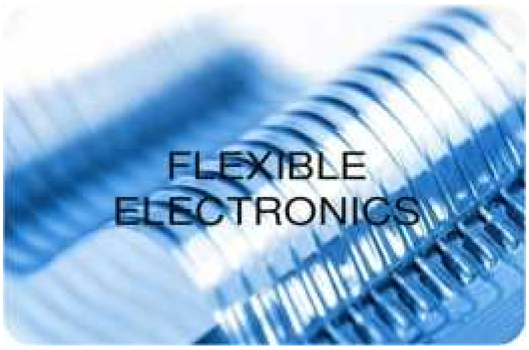

Figure 1. Flexible Electronics

2. MANUFACTURING

Flexible printed circuits (FPC) are made with a photolithographic technology. An alternative way of making flexible foils circuits or Flexible printed circuits (FPC) are made with a photolithographic technology. An alternative way of making flexible foil circuits or flexible flat cable (FFCs) is laminating very thin (0.07 mm) copper strips in between two layers of PET. These PET layers, typically 0.05 mm thick, are coated with an adhesive with an adhesive which is thermosetting and will be activated during the lamination process. FPCs and FFCs have several advantages in many applications:

- Tightly assembled electronic packages, where electrical connections are required in 3 axes, such as cameras (static application).
- Electrical connections where its normal use, such as folding cell phones__(dynamic application).
- Electrical connections between sub-assemblies to replace wire harnesses, which are heavier and bulkier, such as in cars, rockets and satellites

Electrical connections where board thickness or space constraints are driving factors

3. ADVANTAGE OF FPCs.

1. Potential to replace multiple rigid boards or connectors.
2. Single-sided circuits are ideal for dynamic or high-flex applications.
3. Stacked FPCs in various configurations.

4. DISADVANTAGE OF FPCs.

1. Cost increase over rigid PCBs.
2. Increased risk of damage during handling or use.
3. More difficult assembly process
4. Repair and rework is difficult or impossible.
5. Generally worse panel utilization resulting in increased cost.

5. APPLICATIONS

Figure 2. Flexible LCD

- Flex circuits are often used as connectors in various applications where flexibility, space savings, or production constraints limit the serviceability of rigid circuit boards or hand wiring. A common application of flex circuits is in computer keyboards; most keyboards use flex circuits for the switch matrix.
- In LCD fabrication, glass is used as a substrate. If thin flexible plastic or metal foil is used as the substrate instead, the entire system can be flexible, as the film deposited on top of the substrate is usually very thin, on the order of a few micrometres.

- Organic light-emitting diodes (OLEDs) are normally used instead of a back-light for flexible displays, making a flexible organic light-emitting diode display.
- Most flexible circuits are passive wiring structures that are used to interconnect electronic components such as integrated circuits, resistors, capacitors and the like, however some are used only for making interconnections between other electronic assemblies either directly or by means of connectors.
- In the automotive field, flexible circuits are used in instrument panels, under-hood controls, circuits to be concealed within the headliner of the cabin, and in ABS systems. In computer peripherals flexible circuits are used on the moving print head of printers, and to connect signals to the moving arm carrying the read/write heads of disk drives. Consumer electronics devices make use of flexible circuits in cameras, personal entertainment devices, calculators, or exercise monitors.
- Flexible circuits are found in industrial and medical devices where many interconnections are required in a compact package. Cellular telephones are another widespread example of flexible circuits.
- Flexible solar cells have been developed for powering satellites. These cells are lightweight, can be rolled up for launch, and are easily deployable, making them a good match for the application. They can also be sewn into backpacks or outerwear.

6. FLEXIBLE CIRCUIT STRUCTURES

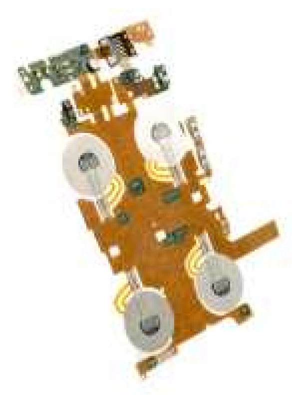

Figure 3. Sculptured flex circuit

There are a few basic constructions of flexible circuits but there is significant variation between the different types in terms of their construction. Following is a review of the most common types of flexible circuit constructions.

6.1 Single-sided flex circuits

Single-sided flexible circuits have a single conductor layer made of either a metal or conductive (metal filled) polymer on a flexible dielectric film. Component termination features are accessible only from one side. Holes may be formed in the base film to allow component leads to pass through for interconnection, normally by soldering. Single sided flex circuits can be fabricated with or without such protective coatings as cover layers or cover coats, however the use of a protective coating over circuits is the most common practice. The development of surface mounted devices on sputtered conductive films has enabled the production of transparent LED Films, which is used in LED Glass but also in flexible automotive lighting composites.

6.2 Double access or back bared flex circuits

Double access flex, also known as back bared flex, are flexible circuits having a single conductor layer but which is processed so as to allow access to selected features of the conductor pattern from both sides. While this type of circuit has certain benefits, the specialized processing requirements for accessing the features limits its use

6.3 Sculptured flex circuits

Sculptured flex circuits are a novel subset of normal flexible circuit structures. The manufacturing process involves a special flex circuit multi-step etching method which yields a flexible circuit having finished copper conductors wherein the thickness of the conductor differs at various places along their length. (i.e., the conductors are thin in flexible areas and thick at interconnection points.).

6.4 Double-sided flex circuits

Double-sided flex circuits are flex circuits having two conductor layers. These flex circuits can be fabricated with or without plated through holes, though the plated through hole variation is much more common. When constructed without plated through holes and connection features are accessed from one side only, the circuit is defined as a "Type V (5)" according to military specifications. It is not a common practice but it is an option. Because of the plated through hole, terminations for electronic components are provided for on both sides of the circuit, thus allowing components to be placed on either side. Depending on design requirements, double-sided flex circuits can be fabricated with protective cover layers on one, both or neither side of the completed circuit but are most commonly produced with the protective layer on both sides. One major advantage of this type of substrate is that it allows crossover connections to be made very easy. Many single sided circuits are built on a double sided substrate just because they have one of two crossover connections. An example of this use is the circuit connecting a mouse-pad to the motherboard of a laptop. All connections on that circuit are located on only one side of the substrate, except a very small crossover connection which uses the second side of the substrate

6.5 Multilayer flex circuits

Flex circuits having three or more layers of conductors are known as multilayer flex circuits. Commonly the layers are interconnected by means of plated through holes, though this is not a requirement of the definition for it is possible to provide openings to access lower circuit level features. The layers of the multilayer flex circuit may or may not be continuously laminated together throughout the construction with the obvious exception of the areas occupied by plated through-holes. The practice of discontinuous lamination is common in cases where maximum flexibility is required. This is accomplished by leaving unbounded the areas where flexing or bending is to occur.

6.6 Rigid-flex circuits

Rigid-flex circuits are a hybrid construction flex circuit consisting of rigid and flexible substrates which are laminated together into a single structure. Rigid-flex circuits should not be confused with ruggedized flex constructions, which are simply flex circuits to which a stiffener is attached to support the weight of the electronic components locally. A ruggedized or stiffened flex circuit can have one or more conductor layers. Thus while the two terms may sound similar, they represent products that are quite different.
The layers of a rigid flex are also normally electrically interconnected by means of plated through holes. Over the years, rigid-flex circuits have enjoyed tremendous popularity among military product designer; however the technology has found increased use in commercial products. While often considered a specialty product for low volume applications because of the challenges, an impressive effort to use the technology was made by Compaq computer in the production of boards for a laptop computer in the 1990s. While the computer's main rigid-flex PCBA did not flex during use, subsequent designs by Compaq utilized rigid-flex circuits for the hinged display cable, passing 10s of 1000s of flexures during testing. By 2013, the use of rigid-flex circuits in consumer laptop computers is now common.
Rigid-flex boards are normally multilayer structures; however, two metal layer constructions are sometimes used.

6.7 Polymer thick film flex circuits

Polymer thick film (PTF) flex circuits are true printed circuits in that the conductors are actually printed onto a polymer base film. They are typically single conductor layer structures, however two or more metal layers can be printed sequentially with insulating layers printed between printed conductor layers, or on both sides. While lower in conductor conductivity and thus not suitable for all applications, PTF circuits have successfully served in a wide range of low-power applications at slightly higher voltages. Keyboards are a common application, however, there are a wide range of potential applications for this cost-effective approach to flex circuit manufacture.

7. FLEXIBLE CIRCUIT MATERIALS

Each element of the flex circuit construction must be able to consistently meet the demands placed upon it for the life of the product. In addition, the material must work reliably in concert with the other elements of the flexible circuit construction to assure ease of manufacture and reliability. Following are brief descriptions of the basic elements of flex circuit construction and their functions.

7.1 Base material

The base material is the flexible polymer film which provides the foundation for the laminate. Under normal circumstances, the flex circuit base material provides most primary physical and electrical properties of the flexible circuit. In the case of adhesive less circuit constructions, the base material provides all of the characteristic properties. While a wide range of thickness is possible, most flexible films are provided in a narrow range of relatively thin dimension from 12 µm to 125 µm (1/2 mil to 5 mils) but thinner and thicker material are possible. Thinner materials are of course more flexible and for most material, stiffness increase is proportional to the cube of thickness. Thus for example, means that if the thickness is doubled, the material becomes eight times stiffer and will only deflect 1/8 as much under the same load. There are a number of different materials used as base films including: polyester (PET), polyimide (PI), polyethylene naphthalate (PEN), polyetherimide (PEI), along with various fluropolymers (FEP) and copolymers. Polyimide films are most prevalent owing to their blend of advantageous electrical, mechanical, chemical and thermal properties.

7.2 Bonding adhesive

Adhesives are used as the bonding medium for creating a laminate. When it comes to temperature resistance, the adhesive is typically the performance limiting element of a laminate especially when polyimide is the base material. Because of the earlier difficulties associated with polyimide adhesives, many polyimide flex circuits presently employ adhesive systems of different polymer families. However some newer thermoplastic polyimide adhesives are making important in-roads. As with the base films, adhesives come in different thickness. Thickness selection is typically a function of the application. For example, different adhesive thickness is commonly used in the creation of cover layers in order to meet the fill demands of different copper foil thickness which may be encountered.

7.3 Metal foil

A metal foil is most commonly used as the conductive element of a flexible laminate. The metal foil is the material from which the circuit paths are normally etched. A wide variety of metal foils of varying thickness are available from which to choose and create a flex circuit, however copper foils, serve the vast majority of all flexible circuit applications. Copper's excellent balance of cost and physical and electrical performance attributes make it an excellent choice. There are actually many different types of copper foil. The IPC identifies eight different types of copper foil for printed circuits divided into two much broader categories, electrodeposited and wrought, each having four sub-types.) As a result, there are a number of different types of copper foil available for flex circuit applications to serve the varied purposes of different end products. With most copper foil, a thin surface treatment is commonly applied to one side of the foil to improve its adhesion to the base film. Copper foils are of two basic types: wrought (rolled) and electrodeposited and their properties are quite different. Rolled and annealed foils are the most common choice, however thinner films which are electroplated are becoming increasingly popular. In certain non-standard cases, the circuit manufacturer may be called upon to create a specialty laminate by using a specified alternative metal foil, such as a special copper alloy or other metal foil in the construction. This is accomplished by laminating the foil to a base film with or without an adhesive depending on the nature and properties of the base film.

MODELLING OF PV SYSTEM

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1. INTRODUCTION

Photovoltaic System Components

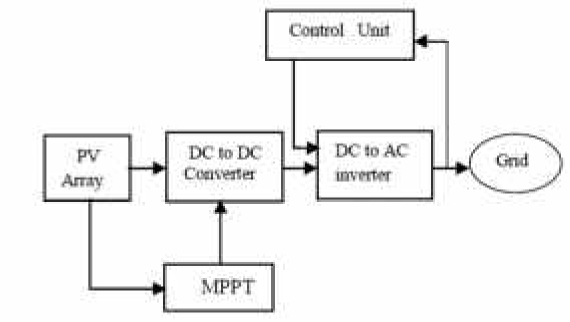

Figure 1. Block diagram of PV system

To be more specific about the parameters and their direction, the following diagram may be used.

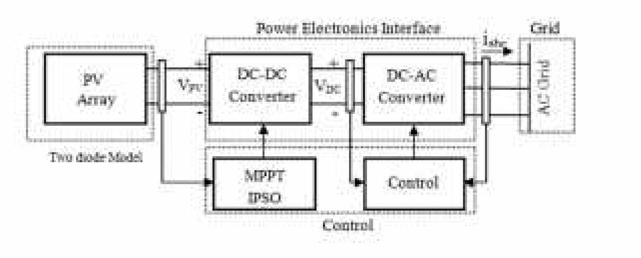

Figure 2. Block diagram of PV system with potential polarity

To be more specific about the components to be simulated for the successful grid connection of the PV system the following diagram may be considered.

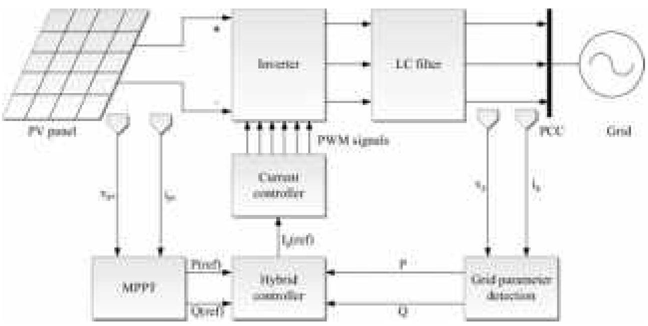

Figure 3. Power flow diagram of PV system

To be more precise about the storage systems and the simulation of the most common faults seen, the following block diagram shows all the components to be designed.

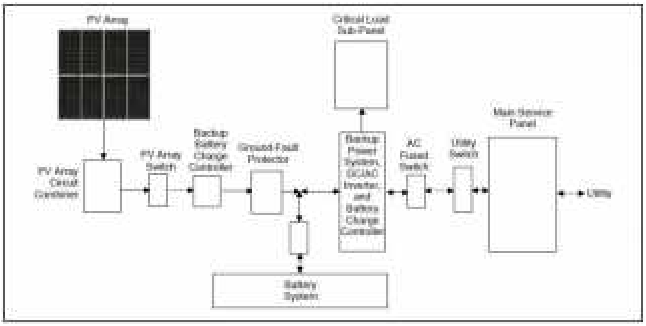

Figure 4. Block diagram of PV system with storage

2. BOOST CONVERTER MODEL

2.1 Basic Function of Boost Converter

The advancement in switching devices has been utilized in changing the electrical parameters into whichever form required. Stepping up or boosting dc voltage is one such popular application. These converters or regulators are used in many instances from providing small supplies where higher voltages are needed in higher power requirements.

The boost converter is very much similar to buck converter but the fundamental circuit for boost or step up converter consists of an inductor, diode, capacitor, switch and error amplifier with switch control circuitry. The circuit for the above mentioned converter operates by varying the time delay of energizing the inductor from the source.

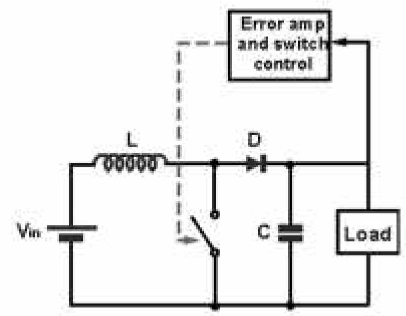

Figure 5. Basic circuitry of boost converter

From the figure showed above the operation of the boost converter can be seen that the output voltage appearing across the load is sensed by sensing the error voltage generated that controls the switch.

The boost converter is controlled by a pulse width modulator, of which the switch remains On for long time so that the current drawn by the load and the voltage tends to drop and often there is a fixed frequency oscillator to control the switching.

2.2 Boost Converter Operation

The operation of the boost converter is simple and straightforward.

When the switch is in the ON position the inductor output is connected to the ground and the voltage Vin is placed across it. The current through inductor increases at a rate equal to Vin/L. As the switch is placed in the OFF position, the voltage across the inductor changes and is equal to (Vout-Vin)/L.

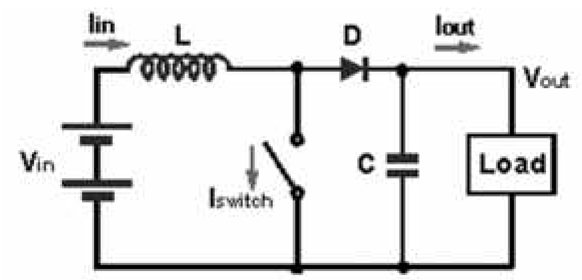

Figure 6. Circuit diagram of Boost Converter

As referred to the above diagram, the current waveforms for the different areas of the circuit are as follows.

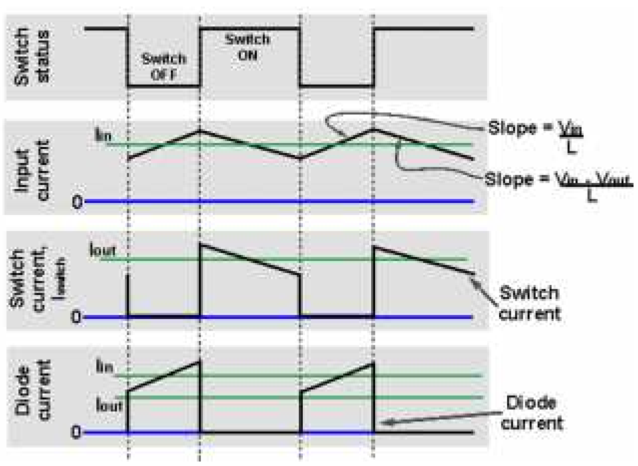

Figure 7. The current waveforms of boost converter

From the above waveforms, it is seen that the input current to the boost converter is higher than the output current. Assuming the converter to be lossless the Power output should be equal to power input. i.e.

$$V_{in} \times I_{in} = V_{out} \times I_{out}$$

Therefore the V_{out} is greater than the V_{in}.

In reality no boost converter will be lossless, but the efficiency level is around 85% and more may be achieved. Boost converter is used to step up a source voltage to a higher voltage. The gain from boost converter is directly proportional to the duty cycle (D). The equation is given by-

$$\frac{Vo}{Vin} = \frac{1}{1-D}$$

The design law of Boost converter is given below:-

$$\text{inductor , L} \geq \frac{Vom * Dm * (1-Dm)}{|\Delta i| * Fsw}$$

$$\text{input capacitor, } C_{in} \geq \frac{Im * Dm^2}{0.02*(1-Dm)*Vinm*Fsw}$$

$$\text{output capacitor, } C_{out} \geq \frac{Im * Dm}{\Delta V * Fsw}$$

here,

Fsw = switching frequency,

ΔV = ripple voltage for capacitor,

Im = output current at maximum output power,

Dm = duty cycle at maximum input power,

Δi = ripple current for inductor,

Vinm = input voltage at maximum power point,

Vom= maximum of output voltage.

I designed a boost converter that can deliver maximum 1kW DC power.

The MATALB[simulink] model of boost converter is given :-

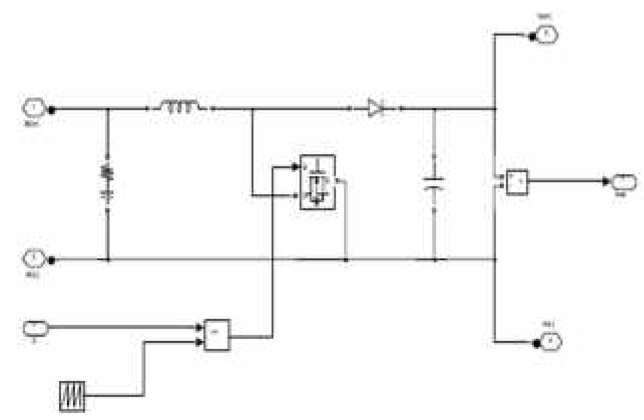

Figure 8. SIMULINK model of Boost Converter

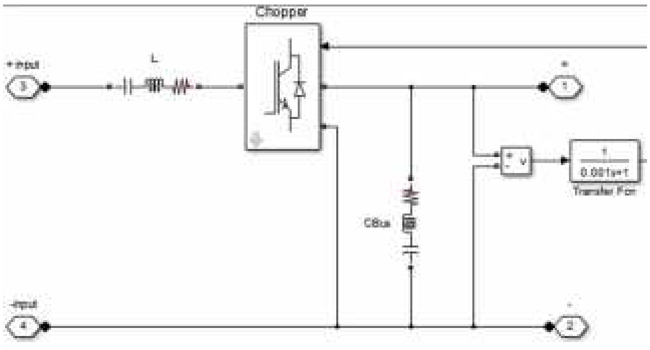

Figure 9. SIMULINK model of Boost converter with measuring blocks

3.1 Maximum Power Point Tracker

The solar system efficiency can be enhanced by tracking the maximum power point. The maximum power point is tracked using the basic principle of maximum power transfer theorem which says that a load receives maximum power from source when the source impedance is equal to load impedance. The maximum power point tracker is a device that extracts maximum power from the solar cell and thereby changes the duty ratio of DC-Dc converter in order to match the load impedance to that of the source. Solar cells have a complex relationship between temperature and total resistance that produces a non-linear output efficiency which can be analyzed based on the I-V curve. It is the purpose of the MPPT system to sample the output of the PV system and apply proper resistance (load) to obtain the maximum power for any set of environmental conditions. MPPT devices are typically integrated into an electric power converter system that provides voltage or current conversion, filtering and regulation for driving various loads, including power grids, batteries or motors.

The solar inverters which convert DC power to AC power and may incorporate MPPT : such inverters sample the output power (I_V curve) from the solar modules and apply the proper resistance (load) so as to obtain maximum power.

The power at the MPP (Pmpp) is the product of the MPP voltage (Vmpp) and MPP current (Impp)

There are many methods to track the maximum power point. The Perturb &Observe (P&O) type MPPT is the most popular.

3.2 Perturb & Observe (P&O) MPPT Algorithm

There are many method of MPPT out of which Perturb & Observe (P&O) technique is mostly used by the researcher due to its simplicity and cost effective. This method works on an algorithm that first PV panel terminal voltage and current are measured and corresponding value of power is measured denoted by $P(n-1)$. The detail algorithm is shown in below flow chart Figure 3 which describes the algorithm for designing the MPP system using P&O by Matlab simulation (Femia, Petrone, Spagnuolo, & Vitelli, 2005). In this algorithm, the module voltage is periodically given a perturbation and the corresponding output power P (n) is compared with the previous perturbing cycle P (n − 1). In this algorithm a slight perturbation is introduce to the system. If the power increases i.e. $P(n) - P(n-1) > 0$ due to the perturbation then the perturbation is continued in the same direction and the duty cycle of the boost converter will increase or decrease depending upon PV panel voltage i.e. $D + \Delta D$ for $V(n) - V(n-1) > 0$ and $D - \Delta D$ for the case $V(n) - V(n-1) < 0$. After the peak power is reached the power at the MPP is zero i.e. at $P(n) - P(n-1) = 0$ and next instant power decreases and hence after that the perturbation is reverses. Where V (n) is the PV panel terminal voltage in (V), V (n − 1) is voltage due to perturbation in (V), I (n) is the PV panel current in (A), P (n) is the PV panel power in (W), P (n − 1) is the power due to perturbation in (W), D is the duty cycle of boost converter, where ΔD is the change in duty cycle.

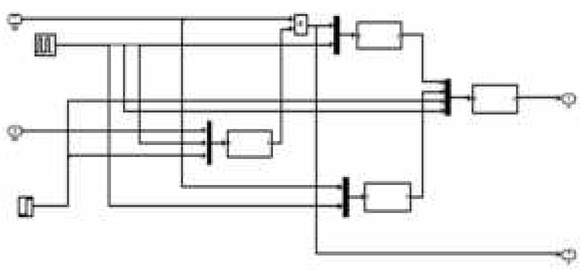

Figure 10. SIMULINK model of P & O type of MPPT

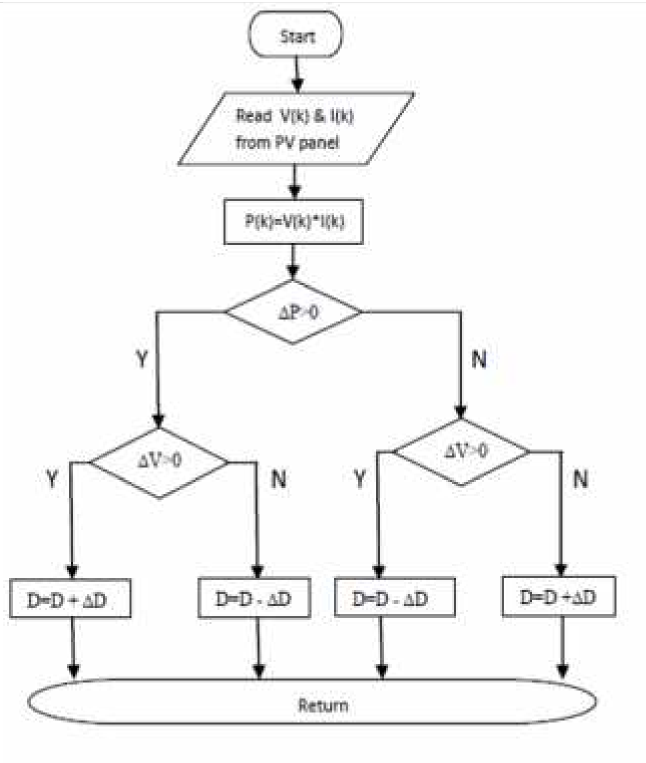

Figure 11. Algorithm of P&O type MPPT

3.3 Proposed Incremental Conductance (IC) Method

Incremental conductance method generally uses voltage and current sensors to detect the output voltage and current of the PV array. The complexity of the algorithm increases therefore. The slope of the PV curve is zero at Maximum Power Point. The incremental conductance (IncCond) method is based on the fact that the slope of the PV array power curve is zero at the Maximum Power Point, positive on the left of the Maximum Power Point, and negative on the right, which is given by dP/dV = 0, at MPP dP/dV > 0, left of MPP dP/dV < 0, right of Maximum Power Point. Since, dP/dV= d(IV)/dV= I + VdI/dV =I+VΔI/ΔV can be rewritten as-

ΔI/ΔV = −I/V, at MPP ΔI/ΔV > − I/V, left of MPP ΔI/ΔV < − I/V, right of Maximum Power Point. The Maximum Power Point can thus be tracked by comparing the instantaneous conductance (I/V) to the incremental conductance (ΔI/ΔV). Vref is the reference voltage at which the PV array is forced to operate. At the MPP, Vref equals to V_{MPP}. Once the Maximum Power Point is reached, the operation of the PV array is maintained at this point unless a change in ΔI is noted, indicating a change in atmospheric conditions and the Maximum Power Point. The algorithm decrements or increments Vref to track the new Maximum Power Point. The Flow chart shown below -

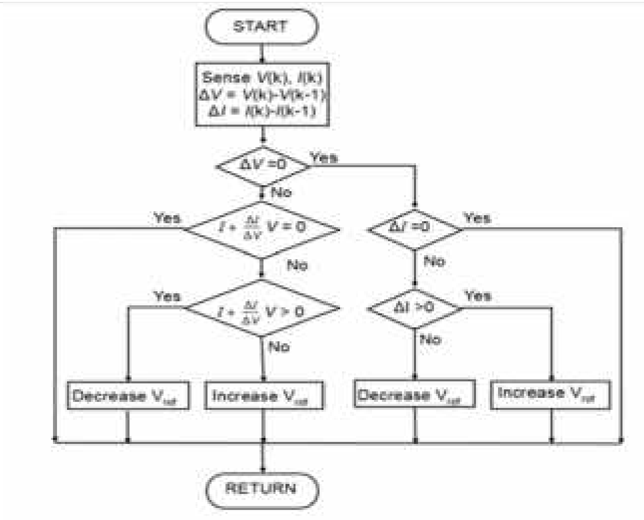

Figure 12. Algorithm of Incremental Conductance Method of MPPT

4. COMPARISON OF P&O TYPE AND IC TYPE MPPT

The P & O and IC MPPT algorithms are simulated and compared using the same conditions. When atmospheric conditions are constant or change slowly, the P&O MPPT oscillates close to MPP but IC finds the MPP accurately at changing atmospheric conditions also. Comparisons between the two algorithms are as follows-

MPPT type	Output current	Output voltage	Output power	Time response	Accuracy	Design complexity
P&O	Less	Less	Less	Less	Less	Simpler
IC	More	More	More	More	More	More complex

Table 1. Comparisons between the algorithms of P&O type and IC type MPPT

The fact that Perturb and Observe type maximum power point tracker is simpler in construction and simulation makes it possible to compromise on the other factors. The P&O type MPPT is most popular.

GRAPHENE

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1. INTRODUCTION

Graphene is a semimetal with small overlap between the valence and the conduction bands (zero band gap material). It is an allotrope (form) of carbon consisting of a single layer of carbon atoms arranged in a hexagonal lattice. It is the basic structural element of many other allotropes of carbon, such as graphite, diamond, charcoal, carbon nanotubes and fullerenes. Graphene and its band structure and Dirac cones, effect of a grid on doping It can be considered as an indefinitely large aromatic molecule, the ultimate case of the family of flat polycyclic aromatic hydrocarbons. Graphene has many uncommon properties. It is the strongest material ever tested, conducts heat and electricity efficiently, and is nearly transparent. Graphene shows a large and nonlinear diamagnetism, greater than that of graphite, and can be levitated by neodymium magnets.

2. PROPERTIES

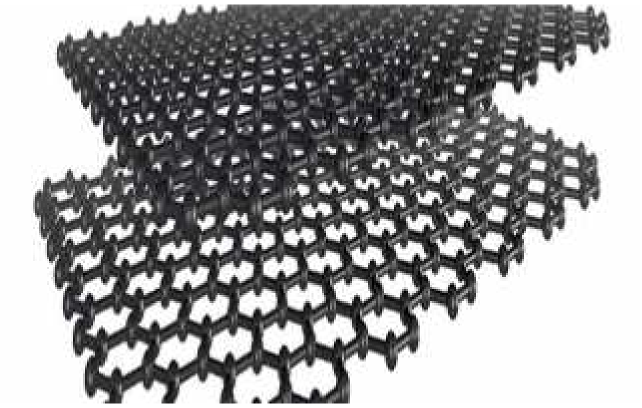

Figure 1. Molecular structure of graphene

Graphene is the thinnest compound known to man at one atom thick, the lightest material known (with 1 square meter weighing around 0.77 milligrams), the strongest compound discovered (between 100-300 times stronger than steel and with a tensile stiffness of 150,000,000 psi), the best conductor of heat at room temperature (at (4.84±0.44) × 10^3 to (5.30±0.48) × 10^3 W·m−1·K−1) and also the best conductor of electricity known (studies have shown electron mobility at values of more than 200,000 cm2·V−1·s−1). Other notable properties of graphene are its uniform absorption of light across the visible and near-infrared parts of the spectrum (πα ≈ 2.3%), and its potential suitability for use in spin transport.

3. GRAPHENE PRODUCTIONS CHALLENGES

The problem that prevented graphene from initially being available for developmental research in commercial uses was that the creation of high quality graphene was a very expensive and complex process (of chemical vapour disposition) that involved the use of toxic chemicals to grow graphene as a monolayer by exposing Platinum, Nickel or Titanium Carbide to ethylene or benzene at high temperatures. Also, it was previously impossible to grow graphene layers on a large scale using crystalline epitaxy on anything other than a metallic substrate. This severely limited its use in electronics as it was difficult, at that time, to separate graphene layers from its metallic substrate without damaging the graphene.

However, studies in 2012 found that by analyzing graphene's interfacial adhesive energy, it is possible to effectually separate graphene from the metallic board on which it is grown, whilst also being able to reuse the board for future applications theoretically an infinite number of times, therefore reducing the toxic waste previously created by this process. Furthermore, the quality of the graphene that was separated by using this method was sufficiently high enough to create molecular electronic devices successfully.

4. POTENTIAL APPLICATIONS

Being able to create super capacitors out of graphene will possibly be the largest step in electronic engineering in a very long time. While the development of electronic components has been progressing at a very high rate over the last 20 years, power storage solutions such as batteries and capacitors have been the primary limiting factor due to size, power capacity and efficiency (most types of batteries are very inefficient, and capacitors are even less so). For example, with the development of currently available lithium-ion batteries, it is difficult to create a balance between energy density and power density; in this situation, it is essentially about compromising one for the other.

In initial tests carried out, laser-scribed graphene (LSG) super capacitors (with graphene being the most electronically conductive material known, at 1738 Siemens per meter (compared to 100 SI/m for activated carbon)), were shown to offer power density comparable to that of high-power lithium-ion batteries that are in use today. Not only that, but also LSG super capacitors are highly flexible, light, quick to charge, thin and as previously mentioned, comparably very inexpensive to produce. Graphene is also being used to boost not only the capacity and charge rate of batteries but also the longevity. Currently, while such materials as silicone are able to store large amounts of energy, that potential amount diminishes drastically on every charge or recharge. With graphene tin oxide being used as an anode in lithium ion batteries for example, batteries can be made to last much longer between charges (potential capacity has increased by a factor of 10), and with almost no reduction in storage capacity between charges, effectively making technology such as electronically powered vehicles a much more viable transport solution in the future. This means that batteries (or capacitors) can be developed to last much longer and at higher capacities than previously realized. Also, it means that electronic devices may be able to be charged within seconds, rather than minute or hours and have hugely improved longevity. Consumers can already purchase graphene-enhanced products to use at home. One company already produces and offers on the market conductive ink (first developed by researchers at the University of Cambridge in 2011). This is made by effectively mixing tiny graphene flakes with ink, enabling you to print electrodes directly onto paper. While this was previously possible by using organic semi conductive ink, the use of graphene flakes makes the printed material vastly more conductive and therefore more efficient.

Another use for graphene along similar lines to those mentioned previously is that in paint. Graphene is highly inert and so can act as a corrosion barrier between oxygen and water diffusion. This could mean that future vehicles could be made to be corrosion resistant as graphene can be made to be grown onto any metal surface (given the right conditions). Due to its strength, graphene is also currently being developed as a potential replacement for Kevlar in protective clothing, and will eventually be seen in vehicle manufacture and possibly even used as a building material. As graphene has been proven to be much more efficient at conducting electrons than silicon, and is also able to transfer electrons at much faster speeds (relatively speaking, 1000 kilometers per second, 30 times faster than silicon), in the next few years you will begin to see products from consumer electronics companies, such as Samsung (who have been pouring money into researching the uses of graphene in telecommunications and electronics and have already taken out a huge number of patents concerned with the uses and manufacture of graphene in electronic devices) based on flexible, robust, touchscreen devices such as mobile smartphones and wrist watches.

This could mean foldable televisions and telephones and eventually electronic flexible newspapers containing all of the publications you are interested in that can be updated via wireless data transfer. Being extremely translucent, in the coming years you can also expect to be able to fit intelligent (and extremely robust) windows to your home, with (potentially) virtual curtains or displaying projected images of your choice.

Combining a few of these aforementioned potential uses, can you imagine car security systems that are connected to the paint on your vehicle? Not only would your car alarm be able to tell you if someone is touching your vehicle, it would be able to record that information and send it to you via your smartphone in real-time. It could also be used to analyses vehicle accidents to determine initial contact patches and resultant consequential energy dispersion. Soon we will begin to see clothing containing graphene-enhanced photovoltaic cells and super capacitors, meaning that we will be able to charge our mobile telephones and tablet computers in a matter of minutes (potentially even seconds) whilst walking to school or work. We may possibly even see security-orientated clothing offering protection against unwanted contact with the use of electrical discharge.

5. HEALTH AND SAFETY

The toxicity of graphene has been extensively debated. A review on graphene toxicity summarized the *in vitro*, *in vivo*, antimicrobial and environmental effects and highlights the various mechanisms of graphene toxicity. Nanotubes of graphene could reproduce the effects of asbestosis. The toxicity of graphene depends on its shape, size, purity, post-production processing steps, oxidative state, functional groups, dispersion state, synthesis methods, route, dose of administration, and exposure times. Graphene Nano ribbons, graphene Nano platelets, and graphene Nano–onions are non-toxic at concentrations up to 50 µg/ml. These nanoparticles do not alter the differentiation of human bone marrow stem cells towards osteoblasts (bone) or adipocytes (fat) suggesting that at low doses graphene nanoparticles are safe for biomedical applications. 10 µm few-layered graphene flakes were able to pierce cell membranes in solution. They were observed to enter initially via sharp and jagged points, allowing graphene to enter the cell. The physiological effects of this remain uncertain, and this remains a relatively unexplored field yet to be come to known in near future

ADVANCED DRIVER ASSISTANCE SYSTEMS (ADAS) AND TECHNOLOGIES

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Demand for advanced driver-assistance systems (ADAS)—those that help with monitoring, warning, braking, and steering tasks—is expected to increase over the next decade, fueled largely by regulatory and consumer interest in safety applications that protect drivers and reduce accidents.

Although ADAS applications are still in their early days, original-equipment manufacturers (OEMs) and their suppliers realize that they could eventually become the main feature differentiating automotive brands, as well as one of their most important revenue sources. And the same technologies that enable today's ADAS offerings could also be used to create fully autonomous vehicles, which are now a major focus of research and development, both at OEMs and at high-tech players that have recently entered the automotive sector, including Google. Any ADAS technology that gains early support could therefore have an advantage if self-driving cars reach the market.

Recently Minister of Road Transport and Highways of India, Nitin Gadkari, shared that the government is planning to make ADAS (Advanced Driver Assistance System) as a mandatory feature in upcoming cars. The ministry aims to implement the plan on all new vehicles (heavy-duty included) by early-2022. Likely by upcoming era ADAS to Become Standard in Indian Cars too. ADAS is a safety package which includes features such as Electronic Stability Control (ESC) or traction control, ABS, lane assist and adaptive cruise control. All these features combined, any vehicle will have far lesser chances of involving in an accident when compared to a regular car.

Let's have a brief overview on ADAS levels:
Society of Automotive Engineers(SAE) has defined six levels of autonomy for self-driving:

Level 0 (No automation): The human driver controls all aspects of driving – from steering to operating the pedals, monitoring surroundings, navigating, and determining when to signal or maneuver. No intervening vehicle system is there. Driver performs all driving tasks.

Level 1 (Driver assistance): Vehicles in some driving modes, can handle steering or throttle and braking – but never both. Some driving assist features such as self-parking and lane assistance fall into this bracket may be included in the vehicle design. However, the driver must be ready to take over those functions if called upon by the vehicle.

Level 2 (Partial assistance): Vehicles can handle the steering and throttle as well as braking in some driving modes. The driver has to be alert at all times and ready to take over the control of the vehicle, and is still responsible for monitoring the surroundings, traffic and road conditions.
An example of Level 2 autonomy is Tesla's Autopilot

Level 3(Conditional assistance): The vehicle can monitor its surroundings, change lanes, and can control the steering, throttle and braking in certain situations, such as on motorways. However, the driver must be ready to take back control of the vehicle when required. When the system reaches its limits the driver is alerted to take over the driving.

The new Audi A8 is the first production car to have Level 3 autonomy. At the push of a button, the A8′s AI Traffic Jam Pilot manages starting, steering, throttle and braking in slow-moving traffic at up to 60km/h on major roads where a physical barrier separates the two carriageways.

Level 4 (High automation): Level 4 automated cars can drive themselves with a human driver onboard. The car takes control of the starting, steering throttle and braking as well as monitoring its surroundings in a wide range of environments and handling the parking duties. When the conditions are right, the driver can switch the car to autonomous mode then sit back, relax and take their eyes off the road. When the vehicle encounters something that it cannot read or handle it will request the assistance of the driver. However, even if the driver does not intervene and something goes wrong, the car will continue to manoeuvre autonomously.

Google/Waymo self-driving vehicle has been operating at the level of autonomy for a few years.

Level 5 (Driverless): At this level, the vehicle needs no human control at all. It doesn't need to have pedals, or a steering wheel, or even a human onboard.

The car is fully automated and can do all driving tasks on any road, under any conditions, whether there's a human on board or not. Till now vehicles are not available commercially.

Some of the existing vehicles with ADAS

Vehicle	**ADAS name**	**Sensors Used**	**Autonomous Features**
Tesla	Tesla Auto pilot	Radar, Camera, Ultrasonic Sensors, GPS	Sense 16 feet around the car in every direction at all speeds, fully integrated autopilot system.
Uber (Volvo XC90)	Volvo Pilot assist	LIDAR: Top mounted Camera array: Front Cameras: Side and rear GPS with roof mounted antenna Radars: Front and Rear	360˚ 3-dimensional scan of the environment Close and far field view for braking vehicles, crossing pedestrians, traffic lights and sign usage Continuous view of the vehicle's surroundings Positioning 360˚ coverage to detect proximity of obstacles
Cadillac (ATS Sedan)	Cadillac super cruise	Lidar (Scanning Laser): Roof Video cameras: Corners, Roof Radar: Front Position sensor: Wheel hub Orientation sensor: Inside	360˚ view around the car Recognize objects around the car Measure speed of cars ahead Location of car from wheel rotations Sensing motion and balance
Toyota (RAV4)	Toyota safety sense	Lidar: Roof Position estimator: Left rear wheel Camera: Near rear view mirror Radars: Spread across front and rear	Create 3D map of car's environment Location on map Detection of moving objects, traffic light signals Measure distance to obstacles in front and back
BMW (7 series)	BMW traffic jam Assistant	GPS Ultrasonic sensors: Side of car High definition stereo video camera Lidar Radar	Position of car. Warning against obstacles. Identify white lines and road signs. Maps surrounding vehicles and objects. Distance from the car in front.
AUDI (A8)	Audi traffic Jam Pilot	Camera: Front Ultrasonic sensors: Front Radar: Front and Rear 360º cameras Ultrasonic sensors: Rear and Side	Traffic sign recognition, left hand turn assist, active lane assist, adaptive cruise control, Traffic jam assist. Adaptive cruise control (ACC) Stop & Go incl. traffic jam assist., Parking system plus, Park assistant Left hand turn assist, ACC, Active lane assist, Collision avoidance, Exit warning, Rear core traffic assist Parking system plus 360º cameras., Parking assist with 360º cameras. Parking system rear, Parking system plus, Parking assist, Active lane assist

Existing autonomous features of ADAS systems (BMW 7 series / Audi A8 / Cadillac ATS Sedan)

Feature	Operation	Control
Traffic light detect	Camera and GPS based. Automatic control of speed based on road speed limit signs.	Brake, Throttle
High beam assist	Front Camera to detect head or tail light of car(s) ahead. Automatic dipping of high beam.	Head lights
Auto park assist	Camera, Ultrasonic Sensors and Radar monitor distance of objects in parking area. Automatic driving for parking.	Brake, Throttle, Steering
Adaptive Cruise Control	Front Camera and Radar based. Within certain range, automatic adaption of speed of vehicle in front. On detection of lane clearance, accelerated as desired.	Brake, Throttle, Steering
Active lane assist	Side Camera, Rear Ultrasonic Sensor/Radar. Checks for danger zone while lane changing, steering vibrates, brake activates in emergency.	Brake, Throttle
Pedestrian detection	Camera near front mirror. Potential hazard from pedestrian, gives alarm, brakes in emergency.	Brake
Active protection /Collision avoidance	All Sensors. Potential collision threat. Automatically follows optimum path to avoid or minimize impact. Takes safety measures such as pre tension of seat belt, closing windows etc.	Brake, Throttle, Steering, Safety features
Night vision assist	Front Infrared Camera. Shows road in night, detects pedestrian or object in front.	Brake

As of now, very few manufacturers offer vehicles with ADAS. Among those automakers are Mercedes-Benz and Volvo Auto — two major names in the automotive industry when it comes to safety. However, being premium brands, the form of ADAS used is much more sophisticated than what can be implemented on a large scale.

Some forms of ADAS can also include blind-spot warning and driver fatigue monitoring. At this point, it is not sure whether such advanced features would come to all cars but sources suggest that autonomous emergency braking is surely in the plans. Hopefully, the new move can reduce the rising road casualty rates in India.

Currently, the road casualty rate in India is almost near 1.5 lakh a year; one of the highest in the world. If ADAS comes as a standard feature on all new vehicles sold in India, the rate of road-related deaths will come down by a good margin. However, if brands have to implement such a feature on all cars, the cost of production and also the final market price will shoot up. Even today, many cars are not offered more than two airbags or ABS to cut costs.

MAGNETIC LEVITATION METHODS AND MODELING IN MAGLEV TRAINS

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1. MAGNETIC LEVITATION (EDS AND EMS)

Magnet interact through the Electro dynamic suspension system and Electromagnetic suspension system, and superconductor also interact through it. Magnetic levitation related to FARADAY'S LAW and LENZ'S LAW. Its working principle is that when a current flow through the coil then induces a magnetic field. Electro dynamic suspension (EDS) describes the EDS based trains has been developed by the Japanese engineers. It uses the magnet which has the same polarity and generate the repulsive force. Repulsive force, then will be high enough to overcome gravitational force and allows it to levitate. If we talk about the electromagnetic suspension (EMS) then it uses the attractive force system which allows to levitate. Conductors will be attracted by the train's magnet.The attractive force between them will overcome the gravitational force. This will in turn levitates the train on the track.

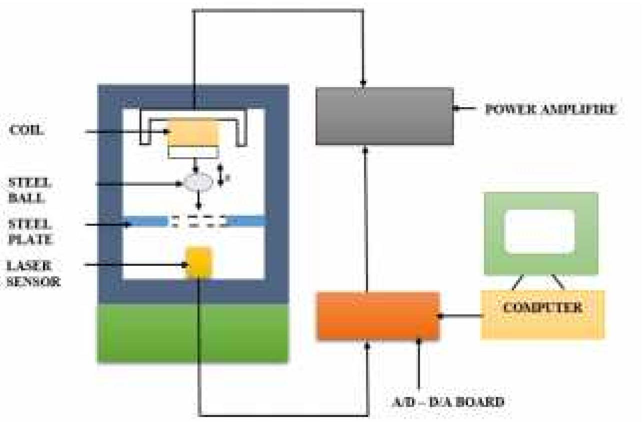

Fig1. Magnetic Levitation Model

2. MODELLING OF MAGNETIC LEVITATION

Here we describe the modelling of magnetic levitation in the three parts –
1) Electromagnetic Dynamic Modeling,
2) Mechanical Modeling,

Electromagnetic Dynamic Modeling- The electromagnetic force is induced by the Current which is flowing through the electromagnetic coil in the model below.

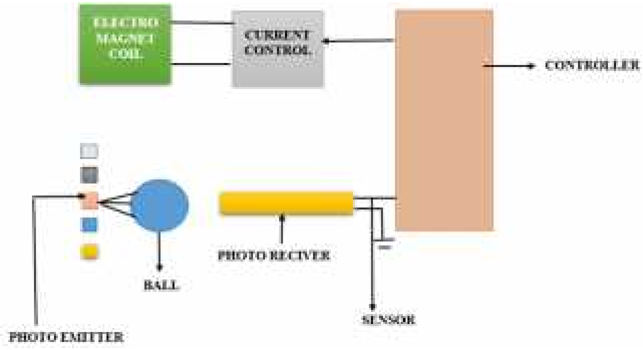

Fig 2. Schematic diagram of magnetic levitation

so we solve this model by Kirchhoff's voltage law:
$V_{in}=V_R+V_L=iR+\frac{d}{dt}L(x)i$
Where,
V_{in} - applied voltage
i - Current in Electromagnet coil
R - Resistance of coil
L - Coil of Inductance.
Mechanical Modeling when the ball is in balance position then $F_g=F_{em}$ it means both the forces electromagnetic force will be equal to gravitational force.

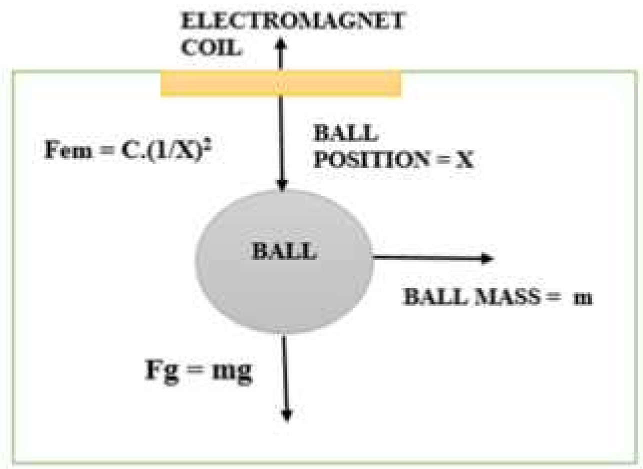

Fig 3: Magnetic Levitation with free body diagram

We applied here Newton's 3rd law of motion while neglecting friction, then the net force on the ball will be-
$F_{net}=F_g-F_{em}$
$mx = mg - C\left(\frac{i}{x}\right)^2$

Where,
G - gravitational constant
C - magnetic force constant

Magnetic levitation has a very advanced and efficient technology. We can use of it in industrial purpose as well as in office and homelike as the fan in buildings, transportation, weapon(gun, rocketry), nuclear reactor, use of elevator in civil engineering, toys, pen.So it has many applications which are using in the whole world. It gives the clean energy and it’s all application gives the lack of contact and thus no friction. Magnetic levitation improves efficiency and life of the system. It reduces the maintenance costs of the system. With the help of in this paper we tried to explain the advantage of it and theneed of it in future engineering and the world. So we can say it is the future of flying trains and cars.

CHALLENGES OF INDIA'S 2020 VISION REGARDING RENEWABLE ENERGY POLICY

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According to Global Data, if India does not make any changes to its renewable energy policy, it will not reach the ambitious target of installation of 175 giga watt (GW) of renewable energy capacity by 2022

Recently, India's effort to accelerate the green energy capacity through auction for 1,200 megawatt (MW) 'hybrid' projects suffered a major setback as the bidders stayed away from the proceedings.

This is the second renewable auction to have failed in October 2018, forcing the state-run Solar Energy Corporation of India (SECI) to extend the deadline for the fifth time. The tender for hybrid projects, which encompasses both wind and solar units at the same site, has now been extended till 14 November 2018.

Mohit Prasad, Power Analyst at GlobalData, says: "In spite of SECI reducing the tender capacity to half of the earlier announced capacity, investors kept away on account of policies associated with it. Policy mandates like tariff ceiling, safeguard duty and mandated manufacturing capacity are responsible for the investors staying away from the auctions."

The government has set a tariff ceiling of $0.035/unit for the hybrid projects. Developers, on the other hand, feel that there should not be any ceiling since the tariff should be driven by the wind density, solar irradiance and the associated competition.

Another deal-breaker is that the tender is forcing developers to enter into the manufacturing sector, which is definitely not their core competence. In order to bid for a project of minimum 2,000 MW of power purchase agreements, the developers are required to set up a 600 MW of manufacturing facility.

In addition, the government has offered a power off-take commitment for two years. Project developers feel that the commitment should be at least for five years so that there is a continuous flow of revenue.

Prasad concludes: "India is currently dependent on 85% of imports of solar products from China. However, the safeguard duty (SGD) of 25% on imports of solar components from China is driving investors away from tenders announced by government bodies. Furthermore, the decision to pass the impact of SGD to consumers while setting a tariff ceiling is also making the investors to channelise their investments in a different direction rather than investing in solar auctions.

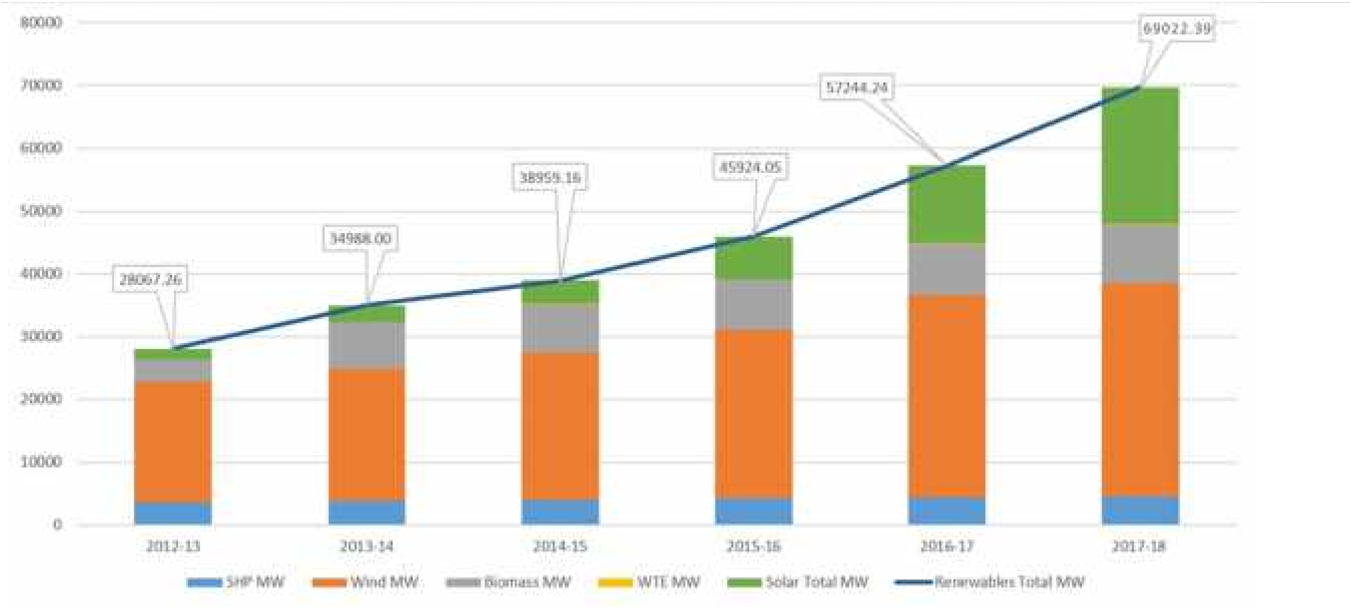
"Unless the government does not make any policy changes, the developers would not be participating in auctions, which ultimately can derail India's

ambitious target of installing 175 GW of renewable energy by 2022."

Year-wise Installed Capacity

(2012-13 to 2017-18)

Year	SHP	Wind	Biomass	WTE	Solar (Total)	Renewables Total
	MW	MW	MW	MW	MW	MW
2012-13	3,632.25	19,051.46	3,601.03	96.08	1,686.44	28067.26
2013-14	3,803.68	21,042.58	7,419.23	90.58	2,631.93	34988
2014-15	4,055.36	23,354.35	7,714.90	90.58	3,743.97	38959.16
2015-16	4,273.47	26,777.40	8,019.75	90.58	6,762.85	45924.05
2016-17	4,379.86	32,279.77	8,181.70	114.08	12,288.83	57,244.24
2017-18	4,485.81	34,046.00	8,700.80	138.3	21,651.48	69,022.39



State/UT and Technology-wise Cumulative Installed Capacity (MW)*						
State/UT and Technology-wise Cumulative Installed Capacity (MW)						
S.N.	State	Solar (Upto 31.12.2017)	Wind (Upto 31.12.2017)	SHP (Upto 31.12.2017)	Biopower (Upto (31.12.2017)	Total RE
1	Delhi	58.02	-	-	-	58.02
2	Haryana	203.85	-	73.5	121.4	398.75
3	Himachal Pradesh	1.48	-	842.11	-	843.59
4	Jammu and Kashmir	2.36	-	161.03	-	163.39
5	Punjab	905.64	-	170.9	194	1270.54
6	Rajasthan	2310.46	4281.72	23.85	119.3	6735.33
7	Uttar Pradesh	550.38	-	25.1	1957.5	2532.98
8	Uttarakhand	246.89	-	214.32	73	534.21
9	Chandigarh	18.89	-	-	-	18.89
Northern Region Total		**4297.97**	**4281.72**	**1510.81**	**2465.2**	**12555.7**
10	Goa	0.71	-	0.05	-	0.76
11	Gujarat	1344.69	5537.37	16.6	65.3	6963.96
12	Chhattisgarh	179.38	-	76	228	483.38
13	Madhya Pradesh	1210.11	2497.79	86.16	93	3887.06
14	Maharashtra	763.08	4777.63	349.175	2065	7954.885

15	D&N Haveli	2.97	-	-	-	2.97
16	Daman and Diu	10.46	-	-	-	10.46
Western Region Total		**3511.4**	**12812.79**	**527.985**	**2451.3**	**19303.475**
17	Andhra Pradesh	2165.21	3834.75	162.11	378.2	6540.27
18	Telangana	2990.07	100.8	90.87	158.1	3339.84
19	Karnataka	1800.85	3793.1	1230.73	1604.6	8429.28
20	Kerala	88.2	51.5	219.02	-	358.72
21	Tamil Nadu	1819.42	7969.5	123.05	893	10804.97
22	Puducherry	0.11	-	-	-	0.11
Southern Region Total		**8863.86**	**15749.65**	**1825.78**	**3033.9**	**29473.19**
23	Bihar	141.52	-	70.7	113	325.22
24	Jharkhand	23.27	-	4.05	-	27.32
25	Orissa	79.51	-	64.625	50.4	194.535
26	West Bengal	39.84	-	98.5	300	438.34
27	Sikkim	0.01	-	52.11	-	52.12
Eastern Region Total		**284.15**	**0**	**289.985**	**463.4**	**1037.535**
28	Assam	11.78	-	34.11	-	45.89
29	Manipur	1.33	-	5.45	-	6.78
30	Meghalaya	0.06	-	31.03	-	31.09
31	Nagaland	0.5	-	30.67	-	31.17
32	Tripura	5.09	-	16.01	-	21.1
33	Arunachal Pradesh	4.39	-	104.605	-	108.995
34	Mizoram	0.2	-	36.47	-	36.67
North East Region Total		**23.35**	**0**	**258.345**	**0**	**281.695**
35	Andaman and Nicobar	12.61	0	5.25	0	17.86
36	Lakshadweep	0.75	0	0	0	0.75
37	Others	58.31	4.3	0	0	62.61
All India Total		**17052.4**	**32848.46**	**4418.155**	**8413.8**	**62732.815**

Source: Annual Report 2017-18, Ministry of New and Renewable Energy

Departmental Vision

To become a nationally recognized centre of excellence in Electrical Engineering

Departmental Mission

M1. To provide training to the students by promoting active learning, critical thinking and engineering judgment coupled with business and entrepreneurial skills to succeed as leading engineers

M2. To prepare students with the capability to meet ever growing socio economic necessity of the industry and society

M3. To create opportunity to encourage self-learning leading to competence of lifelong learning

Departmental PEOs

PEO.1. To produce Electrical engineers having strong foundation in mathematics, science, basic engineering & management for providing solution to industrial problem

PEO.2. To train students with good practical exposure to test & verify the characteristics of common electrical equipments/machines/control system & to develop the skill to analyze, appreciate & interpret the data for engineering applications

PEO.3. To inculcate professional & ethical attitude, communication & team work skills

PEO.4. To inculcate the ability to relate engineering issues from social perspective for truly contributing to the needs of society

PEO.5. To develop attitude to deal with multidisciplinary approach in self-learning.