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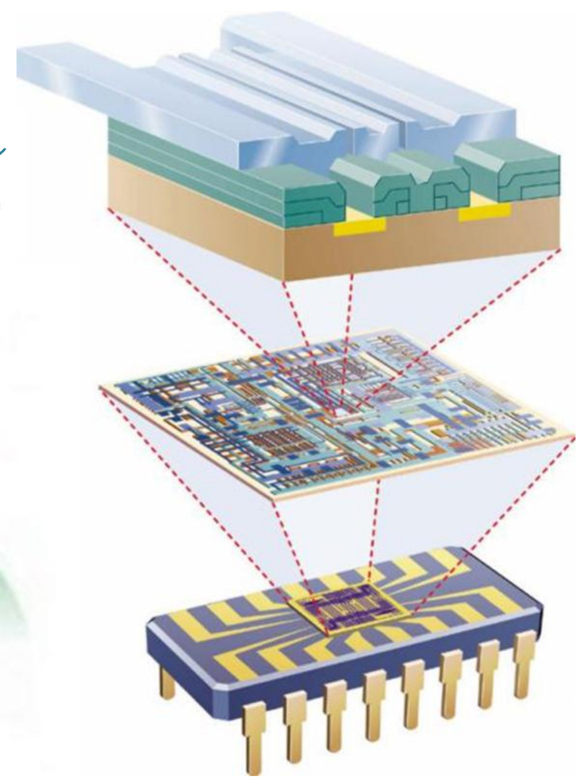
ROLE OF ELECTRONICS IN RENEWABLE ENERGY SYSTEMS



Challenges designing modern day SOC (System-On-Chip)

Google Fiber, 100 times faster than regular Internet connection

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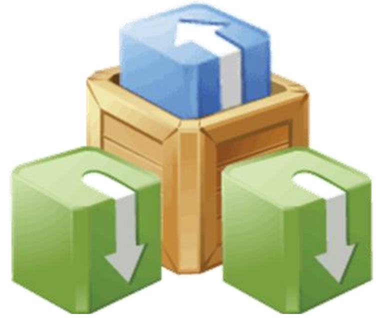

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ROLE OF POWER ELECTRONICS IN RENEWABLE ENERGY SYSTEMS

The rapid increase in global energy consumption and the impact of greenhouse gas emissions has accelerated the transition towards greener energy sources. The need for distributed generation (DG) employing renewable energy sources such as wind, solar and fuel cells has gained significant momentum. Advanced power electronic systems, affordable high performance devices, and smart energy management principles are deemed to be an integral part of renewable, green and efficient energy systems.

The global energy consumption has been continually increasing over the last century. Official estimates indicate a 44% increase in global energy consumption during the period 2006 - 2030. It can be said that fossil fuels (liquid, coal and natural gas) have been the primary energy source for the present day world. Sustained urbanization, industrialization, and increased penetration of electricity have led to unprecedented dependency on fossil fuels. Presently, the most important concerns regarding fossil fuels are the green house gas emissions and the irreversible depletion of natural resources. Based on the official energy statistics from the US Government, the global carbon dioxide emissions will increase by 39% to reach 40.4 billion metric tons from 2006 to 2030. Green house gas emissions and the related threat of global warming and depleting fossil fuel reserves have placed a lot of importance on the role of alternative and greener energy sources.

The quest for cleaner and more reliable energy sources has considerable implications to the existing power transmission and distribution system as well. Traditionally bulk of the power is generated and distributed to the large load centers via transmission lines. The transfer of power was always one way, from the utilities to the consumers. In the immediate future, renewable energy sources cannot support the entire grid by themselves. They have to be connected to the main grid acting as auxiliary power sources reducing the burden on the primary power generation units. They could also be employed to serve load units isolated from the main grid. A power system employing wind powered turbines, fuel cell based sources, micro generators, and photovoltaic systems augmenting the main power lines will constitute a distributed power generation (DG) system. In a DG system end users need not be passive consumers, they can be active suppliers to the grid. Conventionally, important parameters of power delivered (frequency and voltage) are monitored and controlled by the large power generator units (usually consisting of synchronous generators). In case of DG systems, the power electronic interface has to regulate the voltage, frequency, and power to link the energy source to the grid. The focus will be on high power density, robust dc-ac and ac-ac modules with complex control and safety requirements.

This article presents some of the requirements of the power electronic interface as applicable with respect to wind, fuel cell, and photovoltaic power generation units and qualitatively examines the existing power electronic topologies that can be employed. Energy storage is also very important for DG, however, this paper focuses solely on the power electronics aspects of DG. Section I presents an overview of wind power generation and the associated challenges. Section II and III present overviews on power generation based on fuel cells and photovoltaic and its implication on the associated power electronic circuits respectively. Section IV presents the conclusion.

I. WIND ENERGY SYSTEMS

Wind energy has the biggest share in the renewable energy sector. Over the past 20 years, grid connected wind capacity has more than doubled and the cost of power generated from wind energy based systems has reduced to one-sixth of the corresponding value in the early 1980s. The important features associated with a wind energy conversion system are:

- Available wind energy
- Type of wind turbine employed
- Type of electric generator and power electronic circuitry employed for interfacing with the grid

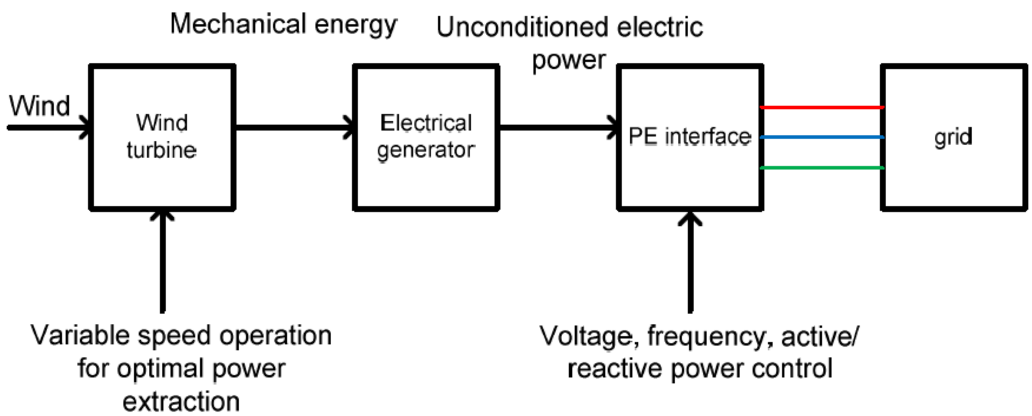


Fig 1: Variable speed wind energy conversion system.

Wind energy – Wind speeds, air pressure, atmospheric temperature, earth surface temperature etc., are highly inter-linked parameters. Due to the inherent complexity, it is unrealistic to expect an exact physics based prediction methodology for wind intensity/sustainability. However, distribution based models have been proposed, and employed to predict the sustainability of wind energy conversion systems.

Based on the aerodynamic principle utilized, wind turbines are classified into drag based and lift based turbines. Based on the mechanical structure, they are classified into horizontal axis and vertical axis wind turbines. With respect to the rotation of the rotor, wind turbines are classified into fixed speed and variable speed turbines. Presently the focus is on horizontal axis, lift based variable speed wind turbines. Power electronic circuits play a crucial enabling role in variable speed based wind energy conversion systems. Fixed speed wind turbines are simple to operate, reliable and robust. However the speed of the rotor is fixed by the grid frequency. As result, they cannot follow the optimal aerodynamic efficiency point. In case of varying wind speeds, fixed speed wind turbines cannot trace the optimal power extraction point. In variable speed wind turbines, power electronic circuitry partially or completely decouples the rotor mechanical frequency from the grid electrical frequency, enabling the variable speed operation. The type of electric generator employed and the grid conditions dictate the requirements of the power electronic (PE) interface. Fig. 1 depicts a variable speed wind energy conversion system. The electrical generator popularly employed for partially variable speed wind energy conversion systems are doubly-fed induction-generators. Fig. 2 depicts a doubly-fed induction-generator where the rotor circuit is controlled by the power converter system via the slip rings and the stator circuit is connected to the grid. This method is advantageous as the power converter has to handle a fraction ~

25% - 50 % of the total power of the system. The power converter system employs a rotor side ac-dc converter, a dc link capacitor, and a dc-ac inverter connected to the grid as shown in Fig. 2. The power converter enables vector control of the field which facilitates active/reactive power control.

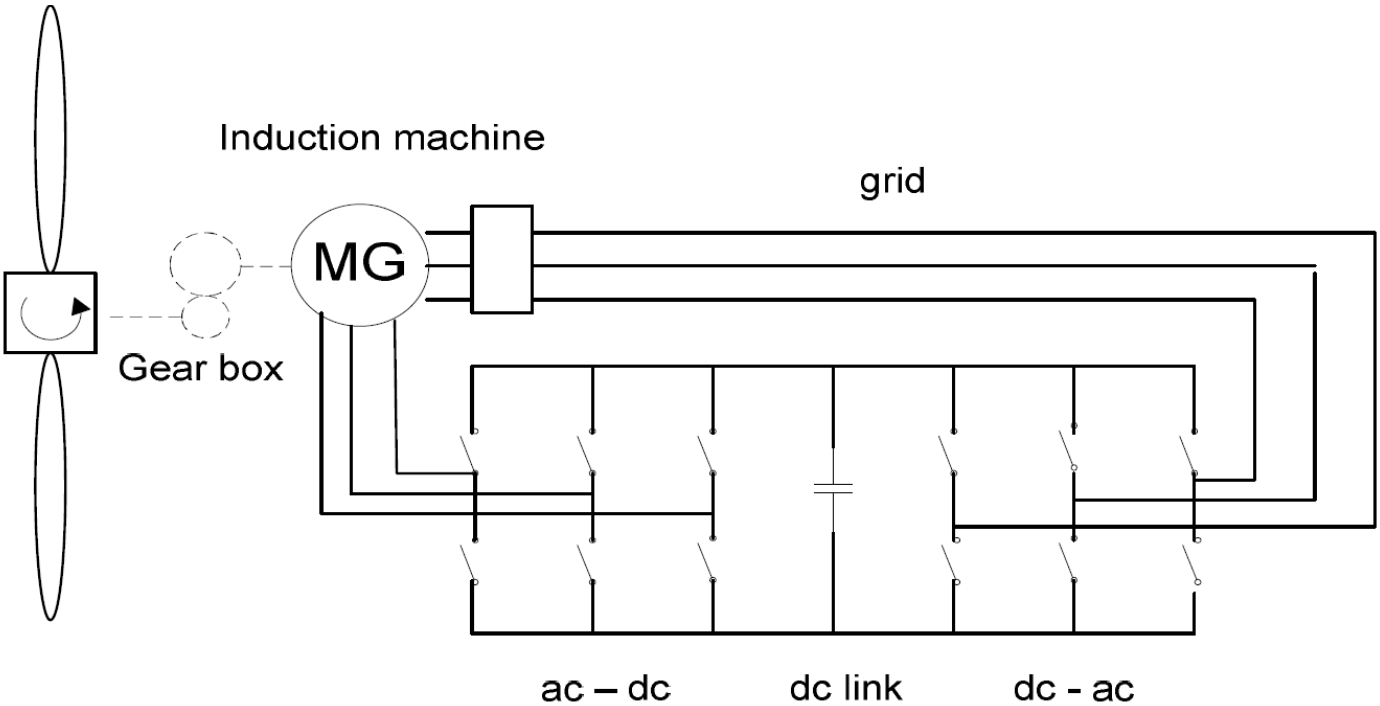


Fig 2: Limited range, variable wind energy conversion system.

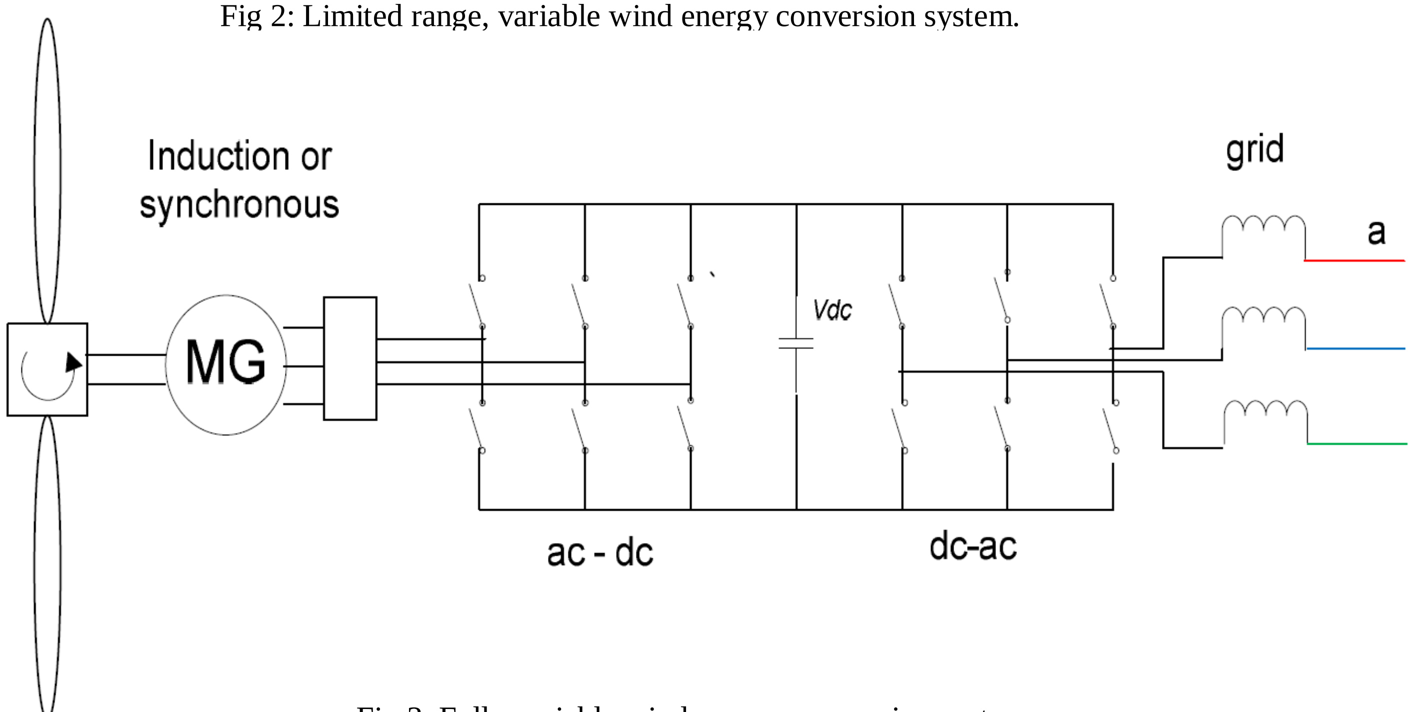


Fig 3: Fully variable wind energy conversion system.

The rotor side converter controls the speed and torque of the rotor and the stator side convertor maintains a constant voltage across the dc link capacitor, irrespective of the magnitude of the rotor power. This method is more efficient than the fixed speed system; however it does not reflect the possible optimal efficiency.

By employing a full scale ac-ac converter system the wind turbine can be completely decoupled from the grid, enabling a wider range of optimal operation. Such a scheme is depicted in Fig. 3. The variable frequency ac from the turbine is fed to the three phase ac-dc-ac converter. The generator side ac-dc converter is controlled to obtain a predetermined value at the terminal of the dc link capacitor. The dc voltage is then inverted using a six-switch dc-ac inverter. Inversion is inherently buck operation hence the turbine side ac-dc converter has to ensure sufficient voltage level is obtained in order to integrate with the grid. If additional boosting of the voltage is required, an additional dc-dc boost converter can to be employed. This increases the overall cost and complexity. To overcome the shortcomings a Z-source inverter based conversion system can be employed. Z-source inverter is a relatively new topology and has the following advantages over the conventional voltage source/current source inverters:

- Buck-boost ability
- Inherent short circuit protection due to Z-source configuration
- Improved EMI as dead bands are not required

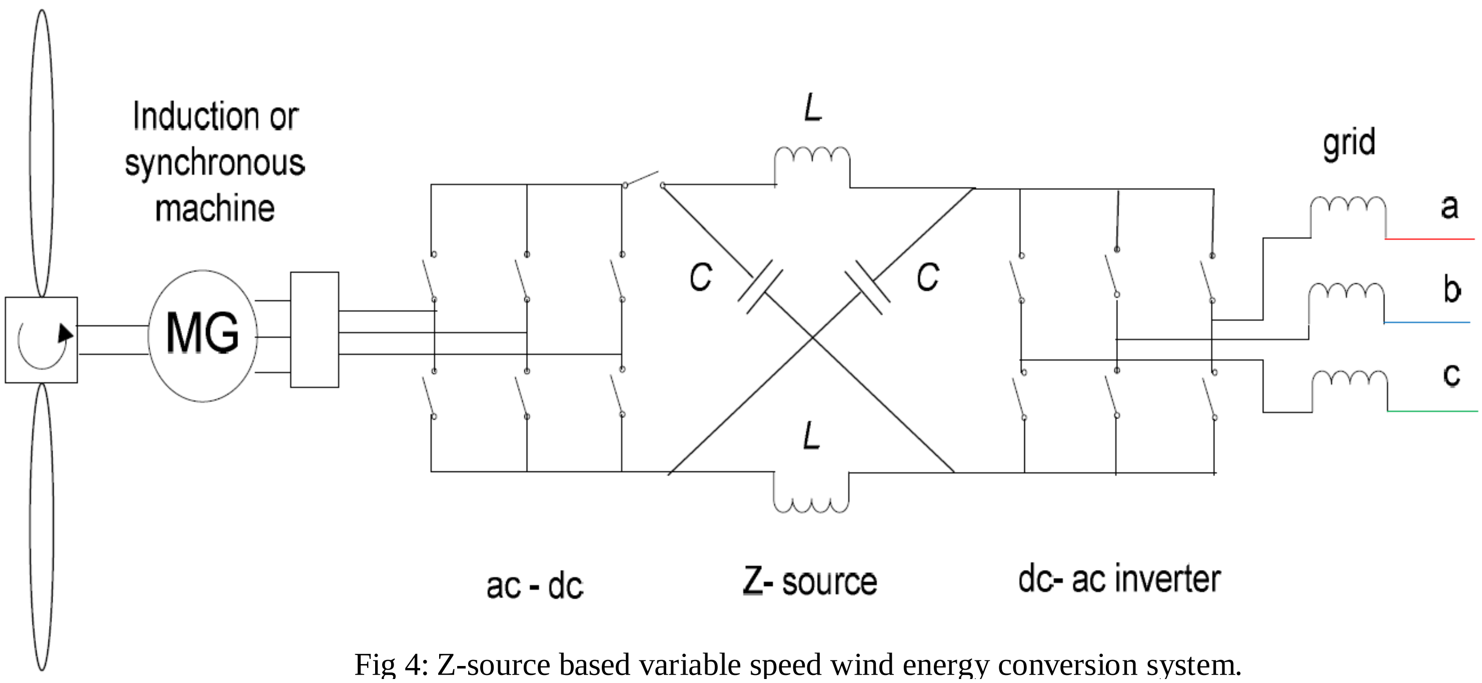


Fig 4: Z-source based variable speed wind energy conversion system.

Z-source inverter based wind power conversion systems are relatively new, however researches are investigating its applicability. Fig. 4 shows a Z-source based wind energy conversion system. A single stage three phase ac-ac Z-source converter.

III. FUEL CELL SYSTEMS

Fuel cells offer clean, non-toxic energy at relatively good energy densities (higher than lead-acid battery) and high reliability. Fuel cells cannot store energy as opposed to a battery, However, they can continually produce electricity. Presently the fuel cells being popularly used are:

- Solid oxide
- Molten carbonate
- Proton exchange membrane
- Phosphoric acid
- Aqueous alkaline

The efficiency of fuel cell systems are ~ 50 %. Along with heat recovery systems the efficiency can be as high as ~ 80 %. This section briefly describes the electrical characteristics of fuel cells and their implications on the power electronic interface circuitry. Fig. 5 shows the typical V-I characteristics of a fuel cell.

The main drawbacks of fuel cells are:

- Inability to store energy - difficult to cold start.
- Output voltage is low varies with the load - requires a boost stage with regulation.
- Low slew rate - hampers dynamic performance, needs backup energy storage.

Due to the above mentioned reasons, auxiliary energy storage along with PE based power conditioning is essential to realize a practical fuel cell based system. The output voltage is low dc and in many cases line frequency ac is required (grid integration), this requires voltage step up and dc-ac inversion. To meet the dynamic load changes, energy back up (battery or ultracapacitor) is required. Various dc-dc converter topologies, dc-ac inversion methods have been evaluated for this purpose by researchers in the past.

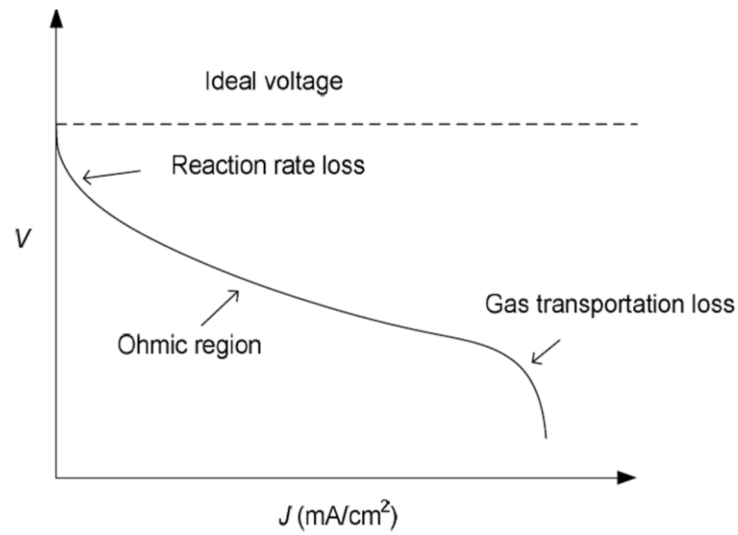


Fig. 5. Typical terminal voltage and current characteristics of a fuel cell [11].

Due to limited boosting capability of non-isolated boost converters, isolated versions have been preferred (turns ratio can be utilized to enhance the overall boost). This also provides electrical isolation improving the overall reliability.

The options for isolated dc-dc converters and their features are discussed below.

- Forward converter – suffers from restrained duty cycle and requires an excitation resetting tertiary winding.
- Push pull – requires centre-tap transformer, not ideally suited for high power applications.
- Full bridge converter – suitable for fuel cell applications. Compared to half bridge dc-dc converter it has more components however the device current stresses are lesser.
- Half bridge dc-dc converter – is well suited for fuel cell applications. For improved efficiency H-bridge based soft switching series resonant converter is more suited. The other advantages of this topology include inherent short circuit protection and no saturation problem of the transformer.

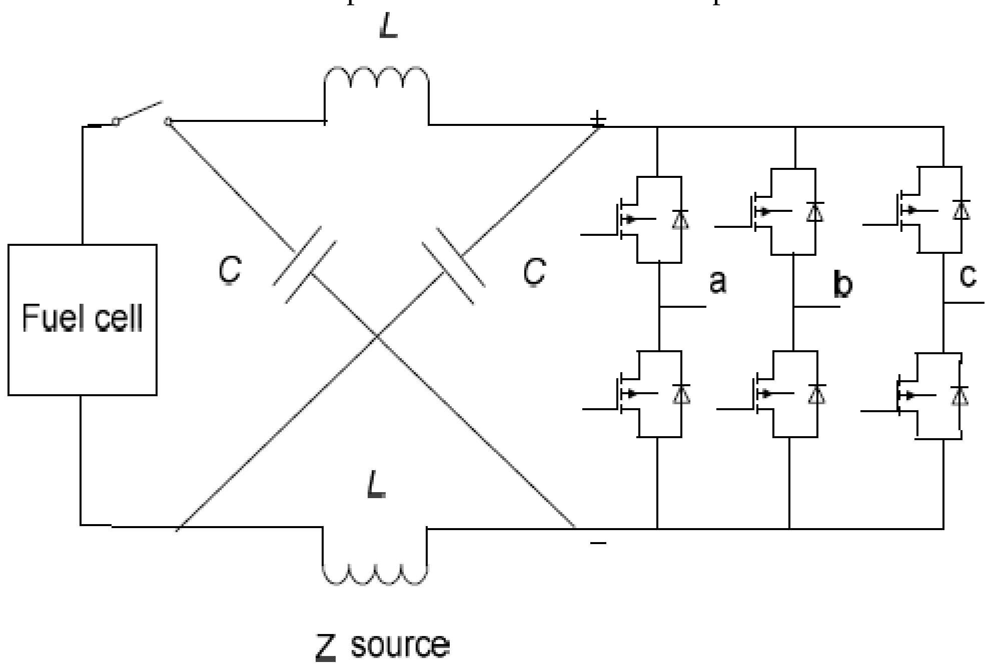


Fig 6: Fuel cell energy conversion system employing a Z-source

Traditionally for dc-ac conversion three phase, six switch VSI have been used extensively. This technique is well established and the control strategies are well developed too. The main drawback of VSI is that its operation is inherently a step down operation. Z-source inverter incorporates the boost feature into the VSI without altering the inherent features of the VSI. This topology appears to be very useful for fuel cell and other renewable energy applications. Fig. 6 shows a fuel cell energy conversion system employing a Z-source dc-ac inverter.

Most of the real time power-electronic enabled energy systems have energy backup in the form of a capacitor bank, ultra-capacitor, or a battery to augment the primary energy source like during dynamic loads. In dc-ac grid connected inverter based systems, since the grid voltage level and frequency are fixed the control variable is limited to being the current. The real and the apparent power being injected into or drawn from the grid have to monitored and controlled using complex control strategies.

III. PHOTOVOLTAIC ENERGY CONVERSION SYSTEMS

Photovoltaic energy systems consist of arrays of solar cells which create electricity from irradiated light. The yield of the photovoltaic systems (PV) is primarily dependent on the intensity and duration of illumination. PV offers clean, emission-less, noise-free energy conversion, without involving any active mechanical system. Since it is all electric it has a high life time (> 20 years). A lot of work is being done to enhance the efficiency of the solar cell which is the building block of PV. In this regard the focus is mainly on electro-physics and materials domain. Some of the existing PVs and their efficiencies are:

- Crystalline and multi-crystalline solar cells with efficiencies of ~11 %.
- Thin film amorphous Silicon with an efficiency of ~10%.
- Thin-film Copper Indium Diselenide with an efficiency of ~12% .
- Thin film cadmium telluride with an efficiency of ~9%.

PV panels are formed by connecting a certain number of solar cells in series. Since the cells are connected in series to build up the terminal voltage, the current flowing is decided by the weakest solar cell. Parallel connection of the cells would solve the low current issue but the ensuing voltage is very low (< 5 V). These panels are further connected in series to enhance the power handling ability. The entire PV system can be seen as a network of small dc energy sources with PE power conditioning interfaces employed to improve the efficiency and reliability of the system.

The role of PE is mainly two-fold:

I. To interconnect the individual solar panels – two solar panels cannot be identical hence a dc-dc converter interfacing the two will help maintain the required current and voltage, and with regulation improve the overall efficiency.

Several non-isolated dc-dc converters have been employed for this purpose. Buck, buck-boost, boost, and Cuk topologies with suitable modifications can be employed for this purpose. Fig. 7 shows a PV system with dc- dc module used to interface the PV panels.

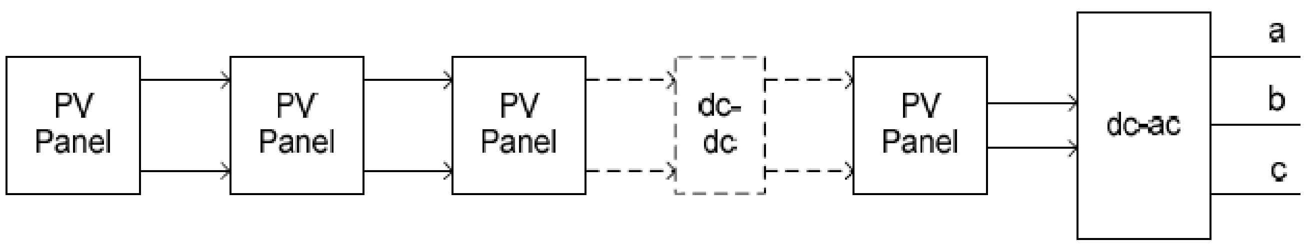


Fig 7: PV system with dc-dc module.

II. To interface the dc output of the PV system to the grid or the load - This includes the previously discussed topics of dc-dc-ac and dc-ac-ac conversion. The topologies considered for fuel-cell system grid interconnection correlates to the grid interconnection of PV based system as well including the usage of the Z-source inverter.

IV. CONCLUSION

The importance of renewable energy, renewable energy based energy conversion systems, and distributed power generation has been reiterated. A brief overview of the wind energy basics and the existing PE interface requirements and techniques have been addressed qualitatively. The basic electrical characteristics of fuel cell and photovoltaic based systems have been presented. The different methods of integrating these systems to the grid have been briefly described. The advantage of employing a Z-source inverter over a conventional dc-ac VSI has been emphasized. It can be concluded that with the advancements being made in the area of renewable energy and distributed power generation power electronics has a demanding and critical role in the future of efficient power generation and distribution.

DESIGN TECHNOLOGY CHALLENGES IN THE SUB-100 NANOMETER ERA

The much-debated Moore's law is expected to hold for another decade, and it is already seen the commercialization of 90 nm and 65 nanometer technologies. Designing chips in these sub-100 nanometre technologies has proven to be a challenge.

Introduction

Ever since Jack Kilby made the first integrated circuit (IC) in 1958, nothing has remained the same except for the incredible rate at which the IC is shrinking in size. Today's engineers are designing IC's targeted for manufacture with 90 nanometer (nm) and 65 nm technologies. Work is already on going on the 45 nanometer node. There were prophecies about the end of the scaling at the turn of the century when it was believed that the wavelength of light was a limit on the feature size. Yet, the submicron and the sub-100 nm technology are now realities. As a consequence, it is now possible to build circuits which are less than one square centimetre in surface area and have more than 100 million transistors on them. With such huge capacity, the IC's that devices designed today are not component chips but systems-on-chip (SoC) where the complete functionality of a system is packed into a small piece of silicon.

Semiconductor Manufacturing Technology Trends

Business needs drive technology. Reducing die sizes reduces costs. It also enables us to integrate multiple features in a single die more economically, leading to super-chips or what is known as System-on-Chip (SoC). Shrinking does not however come for free and is associated with both positives and negatives.

Approximately every two years, device dimensions shrink by 30%, resulting in doubling the number of transistors in the same area. This is also accompanied by doubling clock frequencies and better performance and area. However, physical realities on silicon paint a different picture. Shrinking dimensions are accompanied with reliability and functional issues. The manufacturing process can be subdivided into two parts the Front end of line (FEOL) and the Backend of Line (BEOL).

FEOL deals with the manufacture of Metal Oxide Semiconductor (MOS) transistors. These are basically switches. Shrinking of the transistor leads to electrical stresses, which cause transistors to leak such that they may never completely turn off. Reduced gate oxide thickness causes gate leakage which can be as significant as sub-threshold leakage. Ion implants are required to alter the threshold voltage (VT) of the transistor to ensure there is gate control. BEOL deals with the manufacture of the interconnects. While transistor scaling ensures more packing in the same area, however an efficient metal stack is required to wire all these transistors. If this were not to scale, it would not get to 50% area reduction every technology node. To offset this, metal width and pitch are reducing, and additional layers of metal are being added. The reduction of metal width causes increased resistance, which is compensated by vertical scaling. This leads to increased coupling capacitance which results in more crosstalk between signal lines. Yield is a metric of manufacturability, but is not limited to

process defects. Today, yield can be impacted by crosstalk which could cause glitches on data or clock resulting in intermittent failures which can be impossible to debug if not caught early in the design.

The role of design technology therefore, is to provide SoC designs with the right methodology and flow in order for them to maximally leverage the gains of technology shrink, while insulating them from the electrical challenges caused by scaling.

Design Technology

At a high level, design technology can be viewed as having two separate but interacting parts, namely, Design Components and Design Flow. Design Components consists of the various building blocks that are necessary to create the design. At a minimum it includes a library of logic cells (also known as a standard cell library), input/output (I/O) cells which are needed to interface the chip to the outside world and memory blocks. Increasingly however, as we move to the SoC era design components are getting to be varied and complex and could even be a full-fledged processor. These complex design components are usually referred to as intellectual property (IP) and the ready availability of the right IP often differentiates winners and losers in the race to the market place.

In the nanometer era, timing accuracy has moved into picoseconds, which requires greater accuracy of circuit simulation, and modelling. Since a transistor level circuit simulator would be very inefficient or perhaps impossible to run at the chip level, timing models of the library cells are created. These timing models are pre-characterized tables or equations which capture the input slews and output load seen by a logic gate. Selection of load and slew points is an art. Making this selection without knowing chip level issues, could lead to significant inaccuracies in timing. High speed clocking requires special care in the design of clock buffers so that insertion delays are reduced and cells produce balanced delays for both low to high, and high to low edges. Double data rate (DDR) applications puts further constraints on the duty cycle and correspondingly on the jitter budget.

Physical Design Closure

In the nanometer era, complex electrical effects are making the timely design of functional, reliable chips, a major challenge. These electrical effects are “problems of the small”, since they relate to phenomena that happen in the nanometer scale. The same technology also creates for us, “problems of the large”, since it makes possible the design of chips with hundreds of millions of transistors with a complex interconnection. To further compound the challenge, these effects must be controlled with a methodology and flow that delivers high-performance, low-power, low-cost chips under aggressive time-to-market constraints.

In order to verify the integrity of the design in the presence of these electrical effects, until recently, design flows relied primarily on checkers that are run once the physical design is complete. While such checks are important and necessary in order to highlight the existence of a design integrity problem, the drawback of this approach is that not much help is provided to the designer in order for him/her to quickly solve the problem by modifying the chip layout, i.e., to quickly achieve physical design closure. This challenge is currently being very actively addressed by design technology specialists.

The basic requirement of physical design closure is well understood: a large percentage of manufactured chips should be functionally correct at the required clock speed. However, the manufacturing technology trends that are described previously, have created two physical effects that have complicated this problem. These are the coupling capacitance between signal wires and the voltage drop (IR drop) on the power grid that distributes the power supply to all parts of the chip.

In nanometer technologies, coupling capacitance dominate the total capacitance of a wire, thereby resulting in significant crosstalk between two signal wires that are in close proximity. As a consequence, two complications occur. First, the delay on a path varies significantly depending on the relative switching patterns of wires that are close to each other. Second, substantial glitching can occur for the same reason, resulting in significant reduction in the noise margin and a possible erroneous state in the flip-flop at the tail of the path.

A brief overview of Improvement in VLSI integration

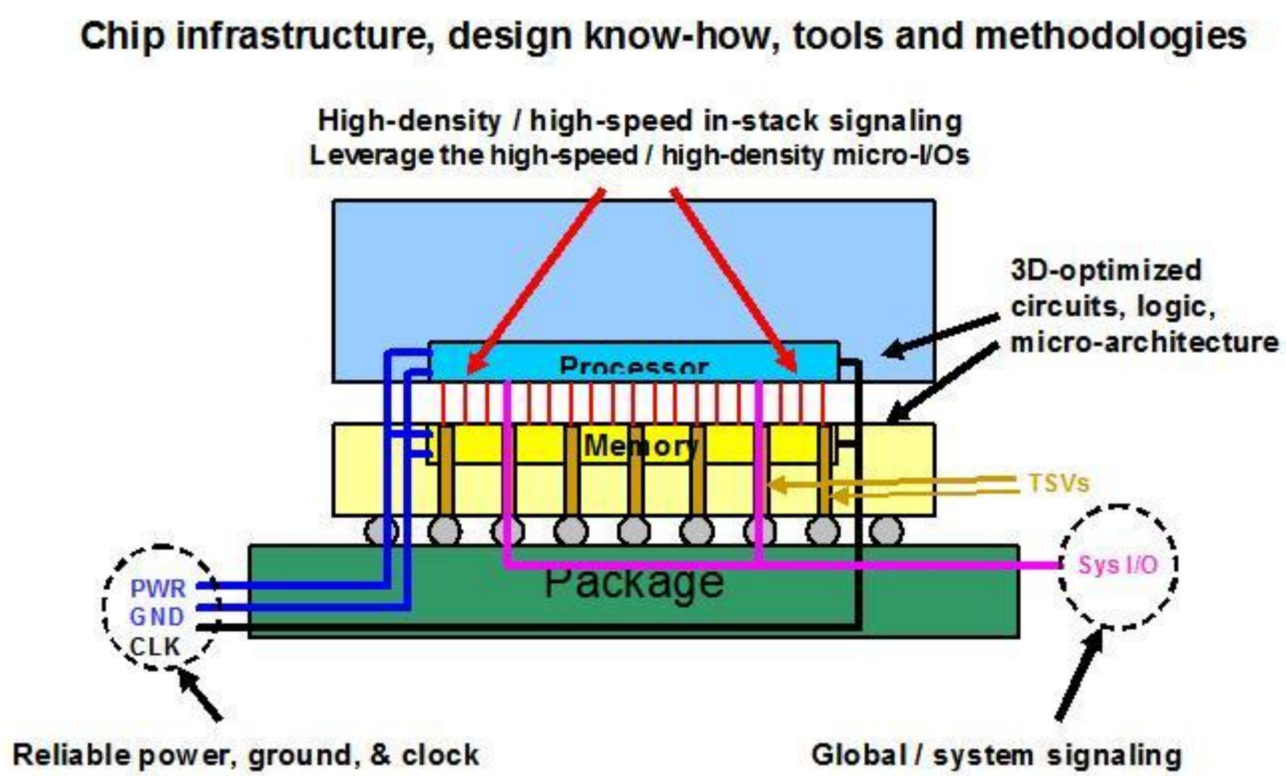
Evolution of VLSI in Microelectronics

Technology	No. of Devices/die	IC Product Example
SSI: Small Scale Integration: 1960-1965	2^1-2^6	Logic Gates, Flops
MSI: Medium Scale Integration: 1965-1970	2^6-2^{11}	Counter, Adder, Mux
LSI: Large Scale Integration: 1970-1980	2^{11} - 2^{16}	8088 uP, RAM, ROM
VLSI: Very Large Scale Integration: 1980-1990	2^{16} - 2^{21}	80286/386 uP, DRAM
ULSI: Ultra Large Scale Integration: 1990-2000	2^{21} - 2^{26}	Pentium Series
GSI: Giga Scale Integration: 2000 onwards	2^{26} - 2^{30}	Many core SOC

Moore's Law: No. of Transistors per die/chip will double every 18 Months !!

3D VLSI Integration

In response to the increasing challenges in maintaining technology advancements through traditional scaling at a pace consistent with Moore's law, alternative methods to achieve enhanced system level performance are becoming increasingly important. 3D Technology has the potential to provide significant performance enhancements for several generations. Realization of this technology will require collaborative research and development across system architecture, design, and technology. Significant changes to the basic circuit design, layout procedures and tools flow, as well as the routing of global signals and supplies (power/ground distribution, clock distribution, and I/O), will be required to accommodate the 3D technology features in stacked active chip designs. These changes can only be understood through a detailed evaluation of the impact of each of the unique 3D technology elements on the design. The Research Division is involved in leading the exploration of these new aspects of 3D VLSI chip design for future systems.



GOOGLE FIBER, 100 TIMES FASTER THAN REGULAR INTERNET CONNECTION

Everyone wants a fast internet service, faster connection means more content can be played, downloaded, displayed in seconds. Good news about the super-fast internet can be enjoyed in kansas city (Kansas State) and Kansas City (the state of Missouri), United States. Exactly three days, July 26, 2012, residents of both cities will enjoy super-fast Internet service from Google with the name **Google Fiber**.

Google Fiber is a service-based internet connection fiber optic network that was initiated by Google. Internet connection speed at up to 1 Gbps, or about 100 times faster than the maximum speed of Internet connections that can be obtained in the United States today.
How fast Google Fiber Internet speed ?

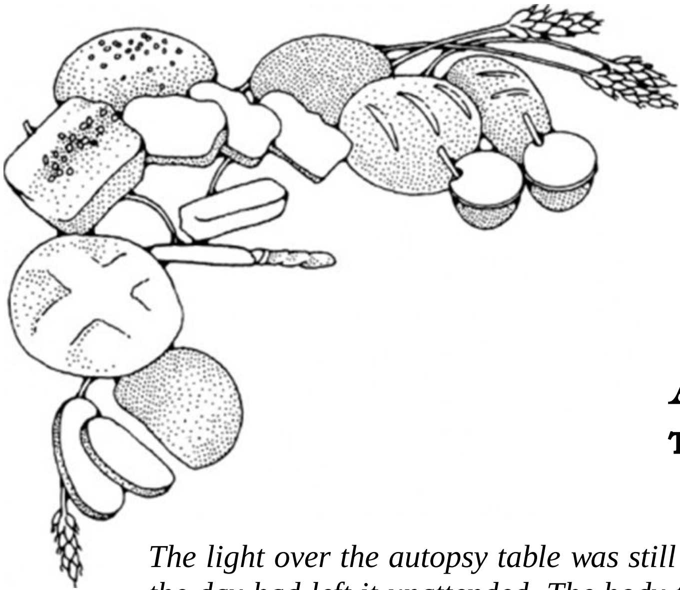
For example, a HD quality movie file that usually must be downloaded for 2 hours 11 minutes, with Google's Fiber can be downloaded for less than 2 minutes (maximum 120 seconds). Other possibilities include combining internet service, TV, and telephone connections in the Google Fiber. So congratulations for Kansas City residents who will enjoy first of Google Fiber.

Silent feature of Google Fiber:

- At 1000 Mbps, Google Fiber is 100 times is faster than todays' average internet connection.
- Google's ultra fast Fiber network has more than enough bandwidth to ensure you get HD in all its glory… with nothing left behind.
- Google Fiber is both your internet and TV. It brings together your devices and gives you the freedom to search, record and save shows.
- Google Fiber provides 2 terabytes of storage so that up to eight programs can be recorded simultaneously.

What is Google Fiber Project?

- A real-life FTTH(Fiber to the home) experiment
  - Covering 50k to 500k households in select cities.
  - Provide 1Gb/s access speed to individual households through FTTH
- Announced Community RFI in Feb 2010
  - More than 1000 municipalities and more than 100k individuals responded to the online RFI



AUTOPSY

The Complete Story

The light over the autopsy table was still flickering. The caretaker in spite of being reminded ten times during the day had left it unattended. The body to be examined was already in place over the table. Shirish looked at his watch impatiently. He had a reputation of attending to his work religiously and efficiently. In his two years in this small town medical college, Shirish has come across a varied range of cases. Most twitchy cases were profusely handed over to him.

Shirish felt himself to be more of a doctor of the dead…he had no complaints. He had quite a passion for this work.

Hearing footsteps approaching, Shirish turned around. The caretaker was hurrying forward with a big, goofy smile on his face.

"Ekhuni kore dichchi sir…sorry sir ektu deri hye gelo…ei dichi ekhuni" He said and rushed inside the room.

While putting in the new light over the table, the caretaker looked at the face of the body and wondered why all the female bodies came to this particular doctor.

Shirish put out his cigarette as he saw the caretaker emerge out of the room. It was already late.

Within moments Shirish had all his instruments and chemicals at the reach of his hand, and he put on his gloves slowly going over in his mind details of this particular case.

Sex:Female, Age:25, Probable cause of death: hit and run, died on spot due to excessive bleeding and damage to the skull…

And then his eyes fell on the face, on her face…

Shirish had been unfamiliar his whole life with the feeling he was going through at the moment…emptiness engulfed his mind instantly. He couldn't feel his scalpel slipping out of his fingers as he pressed both his hands against the table to stop himself from collapsing. The world in front of his eyes was fading but his gaze was fixed at the face. A face he had been longing to see every moment for the past four years but not like this…

Her datasheet lay nearby. He had not checked her name in it before; he never did it with his cases. Only if he had this time…

Name:Nisha Ray

Sex:Female Age:25

Probable cause of death: hit and run, died on spot due to excessive bleeding and damage to the skull.

He took his gloves off, ran through his pocket for the box of cigerrate. His hands continued trembling as he took one out of the box and lighted it. His gaze was fixed at her face. He took a puff inviting into his brain the smoke along with memories he had kept shut away till then…

Shirish felt like experiencing the greatest hallucination of his life. . .flashes of a smiling face came up suddenly from some buried spot in his mind. Her long, silky hair left open as she used to. The fragnance emanating from it was as soothing as he remembered it to be.

His eyes opened and she lay in front of him in the autopsy table,pale and whitened, as quiet as he had never seen her in his life.

Another puff of smoke entered his lungs, and Shirish was again reliving his past.

She was walking alongside him, holding his hand. He said something that made her laugh. They both started laughing and then she looked at him and he was lost in her eyes.

Shirish went up to the table. Her eyes were shut never to open again.

He touched her face. Dead skin.

They were in bed together,wrapped in the same bedsheet. It was raining outside but couldnt match the turbulance of ecstacy within their bodies. He had touched her face in the same way. Softness that defined softness.

The cigerrate butt slipped from his hand. He bent down to pick up the scalpel. He closed his eyes once and opened them immediately. Dr. Shirish had work to do. . .

26th July 2010

Karuna and Nisha

Karuna was growing agitated with every passing second as she was watching Nisha pack her bags. She was her best friend and Karuna believed to know her more than she did herself. However she couldn't make her out this time…

Finally she could no longer remain quiet.

"What are you doing Nisha? Are you completely out of your senses?"

Nisha remained unperturbed with the sudden accusation.

"Why what's wrong Karuna?"

"Nisha, where will you go?"

"I have already told you…"

Karuna was taken aback by the sudden coldness in her voice.

"But how will you find him? I admit it's a small town but. . ." she was almost cajolling her now.

"I will find him…"

"You will find him. You will find him. How? How do you find a man in a town about which you know nothing?? You don't know where he lives...damn it you don't even know what he is called!!!"

"I'll just try my luck" the calmness was back in her voice.

Karuna went quiet. The calmness in Nisha's voice didn't fool her. She knew it was important for her to find this man. Or she wouldn't have been so determined to go…not in this condition.

Varun and Nisha

Varun was waiting outside the house. A deep sense of agony was ruling his mind. He looked up as he heard sound at the front door. Nisha was coming out with her luggage. Seeing her struggle with the bag he went forward to help her.

"So you won't change your mind Nisha?" he said dumping the bag at the back of the car.

Nisha didn't reply. She just stood at the back door of the car. Varun pulled it open for her and she got in. Varun took a seat beside her.

"Thanks for agreeing to drop me Varun" Nisha had a faint smile on her face as she looked up at Varun.

Varun turned his face away.

"Why can't I stay with you?"

"Coz I have to do it alone."

Varun felt jealous and traumatized at the same moment.

"May I know who this man is without seeing whom you can't…" Varun couldn't say the last word of his sentence but Nisha understood.

"Someone very special Varun, someone who has gone through more pain than me in the last three years. He should know now…"

"If he is so special then why is he not with you now?"

Nisha stayed quiet for a moment. Going away from him was not easy. But she had no choice.

"That's because he loved me too much. I couldn't tell him the truth about me. Going away was much easier."

Nisha looked out of the car window and looked the familiar roads and buildings pass by. There was a sudden upsurge of grief in her heart. She pressed her face against the glass of the window and devoured the fleeing glimpses of her so familiar city as if seeing them for the last time in her life. A voice echoed somewhere deep inside her mind…it made her heart go heavy.

Nisha sank back into her seat, tears rolling down from her eyes.

"Let the rain not stop tonight", Shirish said in his minds as he walked aimlessly down the sidewalk.

It was the usual time of the year when the town and its locality experienced thunderstorms almost every evening. Today's although being more turbulent than ever still could not match up to the storm that raged inside him. It hurt, but he had by the course of these many years got used to the idea of not having Nisha in his life. Today he knew that she remained no longer in this world. It numbed his emotions.

Unknowingly, Shirish stepped down from the sidewalk, he was now walking down the middle of the road, lost in the emptiness in his mind, the rain soaking him.

He heard just in time the loud honking of a jeep that had been rushing down the road towards him. He jumped out of the way just in time. Had he had control over his reflex, maybe he wouldn't have cared.

He sat down by the sidewalk, hands closed together. He did not know he was crying, the rain made his tears a part of it. And he just sat there. . .

Shirish opened his eyes two days later at a hospital bed, the very hospital in which he was a doctor.

In an attempt to get up, he became aware of a severe pain throughout his body. He had fever.

A nurse entered, she had a familiar face though Shirish couldn't remember her name.

"They found you unconscious at Central Road sir, hell know what would have happened if they hadn't got there in time. Look at your condition!!!" she seemed genuinely concerned.

Shirish was finding it hard to focus.

"Dr. Mathews what were you doing there?" she asked again.

Ok, that name was familiar somehow, but he couldn't recall where he had heard it.

Another familiar face came into view, a man's this time. Probably a doctor.

"Let Dr. Mathews take some rest now nurse. He still has a pretty high fever."

"Dr. Mathews...why were they calling him so???" Shirish thought, and very slowly he remembered something.

For this town a man named Shirish never existed. To all of them here, he was Dr. Mathews Fernandis.

A FEW DAY AGO

Nisha landed on her bed exhausted. She was facing a dead end. Nowhere, in no hospital could she find any clue to where she could find. The name of Shirish Ganguly was unheard of in this town. The photos of him which she had weren't of much help either. They were 5 years older and depicted a very

jovial and young face which no one in the town recognized.

She was so sure that she would find him here and when she did, she would explain everything to him.

She would tell him why she had to go away from him, and she did that so that he could be happy, cause he deserved a better life, a life with someone who could last longer than she could. . .

someone who had more life left in her than a year.

Deeptarko Das
ECE 3rd year

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