ISSN: 2278 – 7798
International Journal of Science, Engineering and Technology Research (IJSETR)
Volume 2, Issue 5, May 2013

Implementation of Novel Hybrid Wind Solar Energy Conversion System

Mr.P.Pugazhendiran[1], Mr.U.Palani[2] .S.Karthick [3] P.Arulkumar, [4]

***Abstract* - Renewable energy technologies offers clean, abounding energy gathered from self-renewing resources like the sun, wind etc. because the power demand will increases now a days. We implement a fusion of Cuk and SEPIC converters for hybrid energy system to obtain the maximum power from this proposed topology. This configuration permits the sources to provide the load singly or at the same time reckoning on the provision of the energy sources. The proposed hybrid topology is designed and verified by using MATLAB/ SIMULINK. Further more, the high percentage of energy efficient conversion ratio is obtained.**

***Keywords*- Renewable energy, Cuk converter, SEPIC converter, VSI inverter.**

I. INTRODUCTION

Recent developments Associate in modern trends within the electrical power consumption indicate an increasing use of renewable energy. Nearly all regions of the planet have renewable resources of one kind or another. Solar power and wind energy are the two renewable energy sources most typical in use [9]. Wind energy has become the smallest amount dearly-won renewable energy technology breathing and has peaked the interest of scientists and educators over the planet. Electrical phenomenon cells convert the energy from daylight into DC electricity. PVs provide further blessings over different renewable energy sources in this they offer off no noise and need much no maintenance [6]. Hybridization star and wind generation sources give a practical sort of power generation [1].

In this paper, a brand new device topology for hybridization the wind and solar power sources has been planned. During this topology, each wind and solar power sources are incorporated along employing a combination of Cuk and SEPIC converters, so if one among them is unprocurable, then the opposite supply will atone for it. The Cuk-SEPIC coalesced converters have the potential to eliminate the HF current harmonics within the generator. This eliminates the necessity of passive input filters within the system. These converters will support intensify and step down operations for every renewable energy sources. They'll additionally support individual and co-occurring operations. Solar power supply is that the input to the Cuk device and wind energy supply is that the input to the SEPIC device.

The average output voltages created by the system are going to be adding of the inputs of those two systems. This consent of the planned hybrid system creates it extremely economical and reliable.

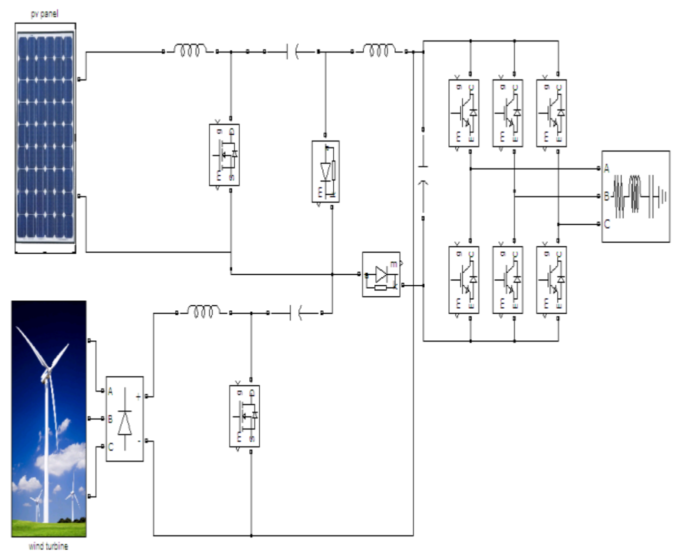


Figure 1: Block Diagram of Hybrid System

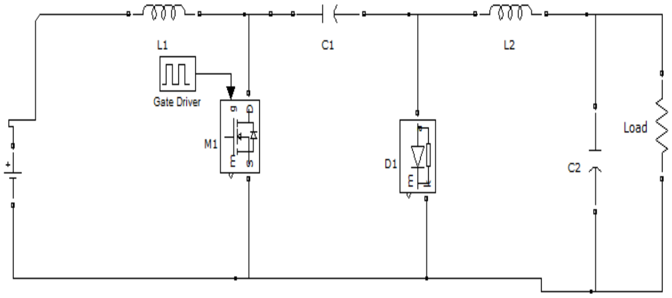
II. DC – DC CONVERTERS

DC-DC converters will be used as switch mode regulators to convert unregulated dc voltage to a regulated dc output voltage. The regulation is often achieved by PWM at a hard and fast frequency and also the switch device is mostly BJT, MOSFET or IGBT.

A. Cuk Converter

The Cuk device could be a variety of DC-DC convertor that has associate output voltage magnitude that's either larger or the input voltage magnitude. It has the capacity for each step up and step down operation. The output polarity of the device is negative with relevancy the common terminal. This device forever works within the continuous physical phenomenon mode [10].

The Ćuk device operates via electrical phenomenon energy transfer. Once m_1 is turned on, the diode D_1 is reverse biased, the present in each L_1 and L_2 will increase, and therefore the power is delivered to the load. Once M_1 is turned off, D_1 becomes forward biased and therefore the electrical condenser C_1 is recharged. The voltage conversion quantitative relation MCUK of the Cuk device is given



by

Figure 2.1 CUK converter

B.SEPIC Converter

Single-ended primary-inductor device (SEPIC) could be a style of DC-DC device permitting the voltage at its output to be larger than, less than, or adequate that at its input. it is the same as a buck boost device. it has the aptitude for each accelerate and step down operation. The output polarity of the device is positive with relation to the common terminal

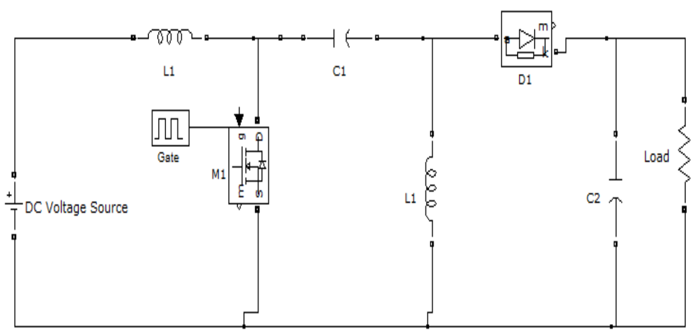


Figure 2.2 SEPIC converter

The electrical device C_1 blocks any DC current path between the input and also the output. The anode of the diode D_1 is connected to an outlined potential. Once the switch M_1 is turned on, the input voltage, V_{in} seems across the electrical device L_1 and also the current I_{L1} will increase [6]. Energy is additionally kept within the electrical device L_2 as before long because the voltage across the electrical device C_1 seems across L_2. The diode D_1 is reverse biased throughout this era. However once M_1 turns off, D_1 conducts. The energy keep in $L_1$and L_2 is delivered to the output, and C_1 is recharged by L_1 for consecutive amount[9].

III. PROPOSED HYBRID SYSTEM

A system diagram of the projected rectifier stage of a hybrid energy system is shown in Figure 3, wherever one amongst the inputs is connected to the output of the PV array and also the different input connected to the output of a generator [7].

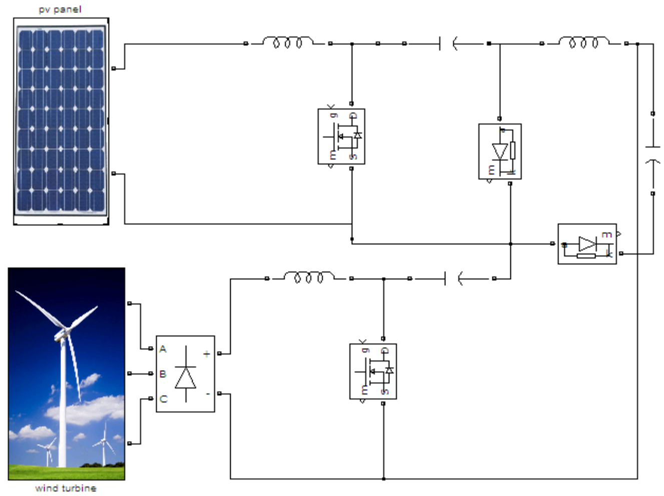


Figure 3. Hybrid system

The fusion of the two devices is achieved by reconfiguring the two existing diodes from every converter and also the shared utilization of the Cuk output electrical device by the SEPIC converter. This configuration permits every device to control commonly separately within the event that one supply is unobtainable. Figure 3.1 illustrates the case once solely the wind supply is offered. During this case, D_1 turns off and D2 turns on; the projected output voltage relationship is given by (1). On the opposite hand, if solely the PV supply is offered, Figure 3.2 then D_2 turns off and D_1 can forever get on and therefore the circuit becomes a Cuk device as shown in the input to output voltage relationship is given by (2). In each case, each converter has step I up/down capabilities, which give additional style flexibility within the system if duty quantitative relation management is employed to perform MPPT management [7].

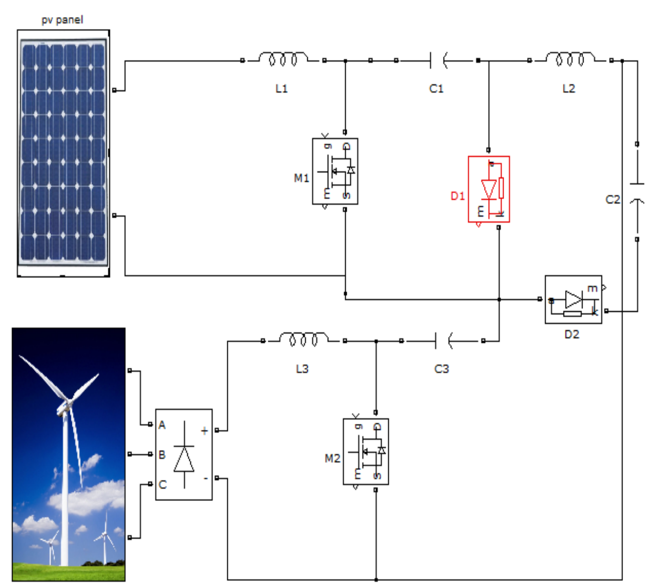


Figure 3.1 Wind Source (SEPIC)

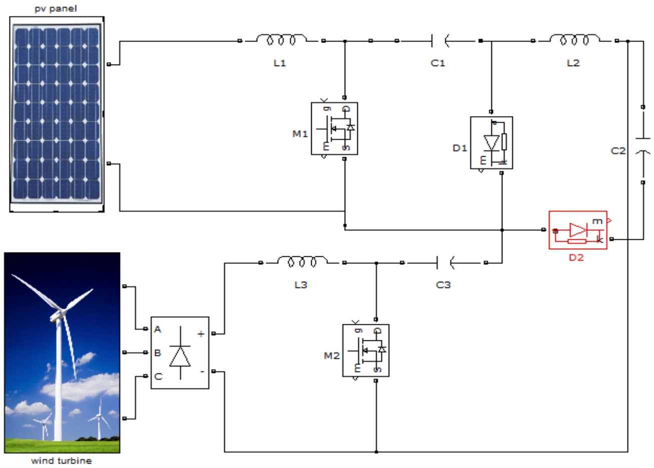


Figure 3.2 Solar (CUK)

$$\frac{V_{dc}}{V_w} = \frac{d_2}{1-d_2} \quad (1)$$

$$\frac{V_{dc}}{V_{pv}} = \frac{d_1}{1-d_1} \quad (2)$$

Solving the equations gives the output DC bus voltage Vdc as.

$$V_{dc} = \left(\frac{d_1}{1-d_1}\right) V_{pv} + \left(\frac{d_2}{1-d_2}\right) V_w \quad (3)$$

It is determined that V_{dc} is solely the add of the 2 inputs of the Cuk and SEPIC device. V_{dc} is controlled by d_1 and d_2 singly or at the same time.

IV. MODELING OF PV PANEL

A cell is comprised of a p-n junction semiconductor material like silicon that produces currents via the electrical phenomenon impact. Once light-weight energy strikes the photovoltaic cell, electrons area unit knocked loose from the atoms within the semiconductor material. If electrical conductors are connected to the positive and negative sides, forming associate electrical device, the electrons will be captured within the kind of an electrical current. This electricity will then be wont to power a load. The low voltage is generated during a PV cell (around zero.5V), many PV cells are connected nonparallel (for high voltage) and in parallel (for high current) to make a PV module for desired output [8].

A. PV Cell Characteristics

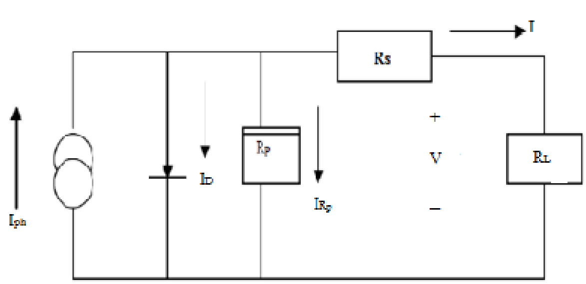


Figure 4.1 PV Cell Equivalent Circuits

A PV cell may be delineated by a current supply connected in parallel with a diode, since it generates current once it's well-lighted and acts as a diode once it is not. The equivalent circuit model additionally includes a shunt and series internal resistance. R_s is that the intrinsic series resistance. Whose worth is very small. R_p is the equivalent shunt resistance which has a very high value.

The current – voltage characteristic equation of a PV cell is given by.

$$I = n_p I_{ph} - n_p I_{rs}\left(\exp\left(\frac{qv}{KTAn}\right) - 1\right) I \quad (4)$$

V. MODELING OF WIND TURBINE

The turbine is that the 1st and foremost part of wind generation systems. Wind turbines capture the facility from the wind by means that of aerodynamically designed blades and convert it to rotating mechanical power. This mechanical power is delivered to the rotor of an electrical generator wherever this energy is reborn to electricity. Electrical generator used is also associate degree induction generator or synchronous generator [2], [6].

The mechanical power that is generated by the wind is given by:

$$p_w = \frac{\rho}{2} c_p.(\lambda, \theta) A_r V_w^3 \quad (5)$$

Where

- ρ - Air density
- *A* - Rotor swept area
- *Cp (λ, β)* - power coefficient function,
- λ - Tip speed ratio
- β - Pitch angle
- v *w* -wind speed.

The turbine model is connected to a cage asynchronous generator. The energy obtained from the turbine is fed to the generator that converts it to the electricity [2].

VI. SIMULATION MODEL

PV array, Wind turbine, and the proposed hybrid system is modelled using MATLAB/ SIMULINK software.

A. *Simulink Model of PV Array*

The Simulink model of PV array is shown in Figure 6.1(a) shows the IV characteristics curve of the PV modelling .This explains the details about the each PV cells characteristic for every variation of sun light directions with respect to the time [7].

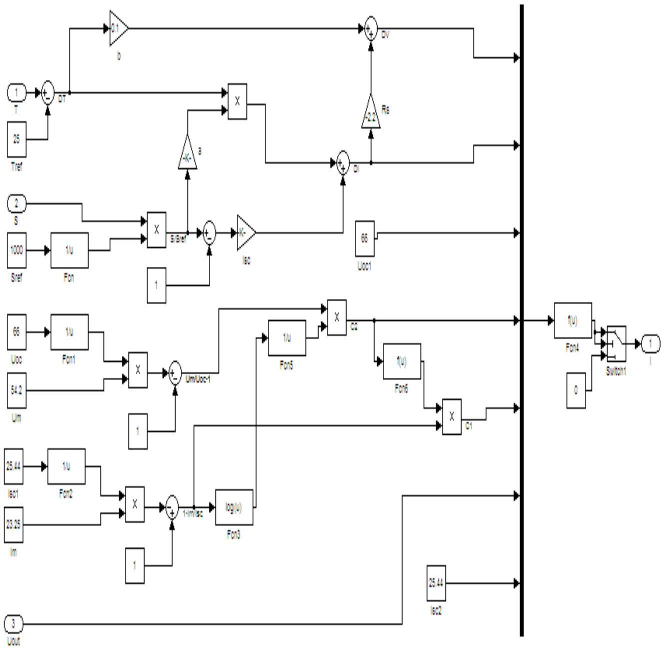


Figure 6.1 Simulink model of PV Array

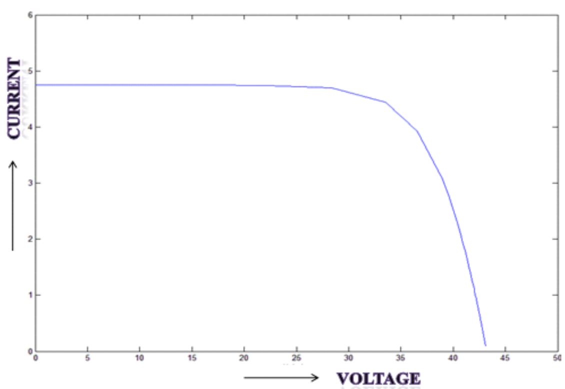


Figure 6.1a I-V curve characteristics

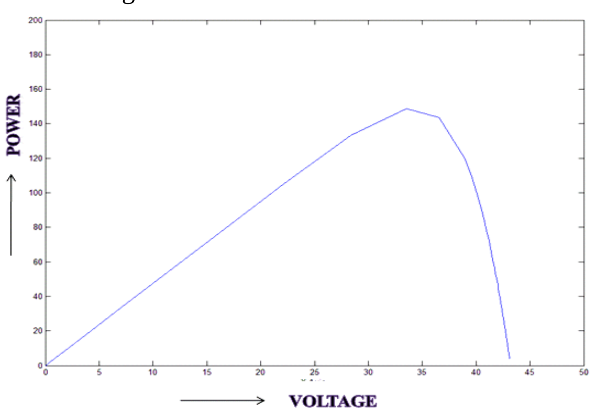


Figure 6.1b PV Curve Characteristics

B. Simulink Model of Wind Turbine

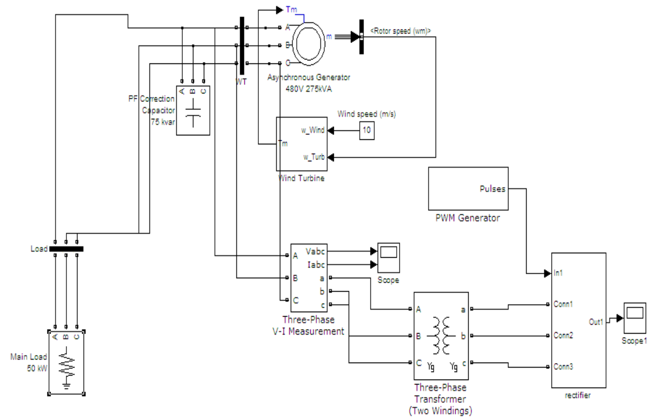


Figure 6.2 Simulink model of Wind Turbine

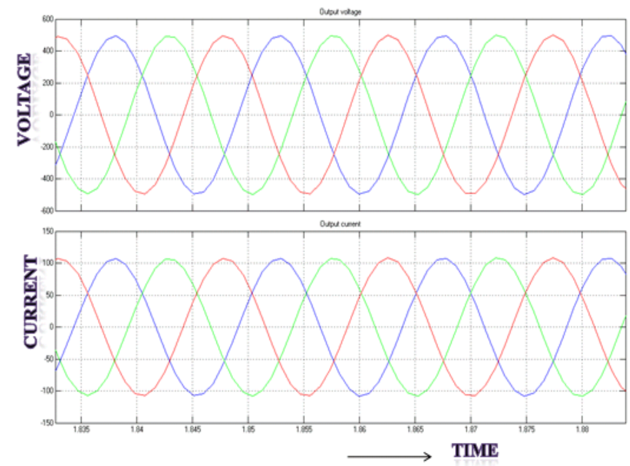


Figure 6.2a Output Waveform of Wind Turbine

c. Simulink Model of Proposed hybrid System.

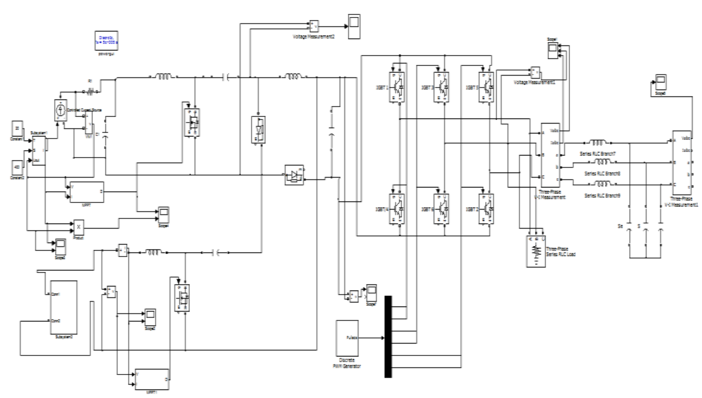


Figure 6.3.Simulink Model of Proposed Hybrid Converter

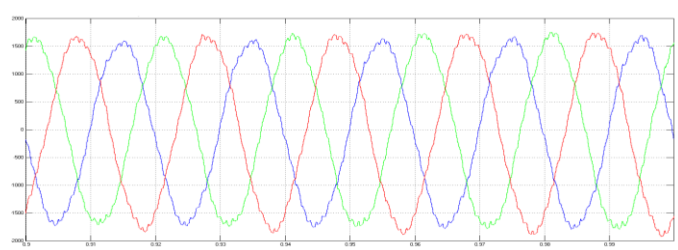


Figure 6.3a Output Waveform.

ISSN: 2278 – 7798
International Journal of Science, Engineering and Technology Research (IJSETR)
Volume 2, Issue 5, May 2013

VII. CONCLUSION

Renewable energy sources conjointly referred to as non-conventional approach of energy area unit ceaselessly replenished by natural processes. Here, a hybrid wind and alternative energy system with a convertor topology is considered that makes use of Cuk and SEPIC converters within the technique. This converter method overcomes the drawbacks of the sooner planned converters. This topology permits the two sources to provide the load severally or at the same time counting on the supply of the energy sources. The output voltage obtained from the hybrid system is that the addition of the inputs of Cuk and SEPIC converters. This technique has lower overhead and find applications in remote space power generation, constant speed and variable speed energy conversion systems and rural electrification. The proposed system is employed by using MATLAB/ SIMULINK to model the PV panel, turbine, DC-DC converters and therefore the planned hybrid system.

VIII. REFERENCES

[1] A. Bakhshai et al., "A Hybrid Wind – Solar Energy System: A New Rectifier Stage Topology",IEEE Magazine, July 2010.

[2] R. Bharanikumar and A. Nirmal Kumar, "Analysis of Wind Turbine Driven PM Generator with Power Converters", International Journal of Computer and Electrical Engineering, Vol. 2 [4], August, 2010.

[3] R. Billinton and R. Karki, "Capacity Expansion of Small Isolated Power Systems Using PV and Wind Energy", IEEE Transactions on Power Systems,Vol. 16 [4], November 2001.

[4] Chen et al., "Multi-Input Inverter for Grid-Connected Hybrid PV/Wind Power System", IEEE Transactions on Power Electronics, vol. 22, May 2007.

[5] D. C. Drago and G. Adrian, "Modeling of renewable hybrid energy sources", Scientific Mures, Vol. 6, 2009.

[6] Teena Jacoband Arun S , "Modeling of Hybrid Wind and Photovoltaic Energy System using a New Converter Topology" , Electrical and Electronics Engineering: An International Journal (EEEIJ) Vol.1, No.2, August 2012

[7] P.Varun and M. Nirmala, "A Cuk-Sepic based Modular Design Methodology for Smart Grid Inverters" International Journal of Technology And Engineering System(IJTES): Jan –March 2011- Vol.2.No.3

[8] Kim et al., "Dynamic Modeling and Control of a Grid-Connected Hybrid Generation System with Versatile Power Transfer", IEEE transactions on industrial electronics, VOL. 55 [4], April 2008

[9] N. A. Ahmed, M. Miyatake, and A. K. Al-Othman, "Power fluctuations suppression of stand-alone hybrid generation combining solar photovoltaic/wind turbine and fuel cell systems," in Proc. Of Energy Conversion and Management, Vol 49, 2008.

[10] Shagar, B.M. "Design of DC - DC converter for hybrid wind solar energy system" International Conference on Computing, Electronics and Electrical Technologies (ICCEET), 2012

IX.BIOGRAPHY

P.Pugazhendiran was born in Tamilnadu, on 1979. Received his UG degree in Electrical and Electronics Engineering from Coimbatore Institute of Technology (CIT) in 2001 and PG degree from College of Engineering Guindy (CEG), Anna University, Chennai in 2009. His research interest includes Power quality issues, Power Converters, Renewable energy sources, Electrical Drives. He Published More than 5 Engineering Books. Teaching Experience over a decade. He published more than 10 National and International journals He is currently working at I.F.E.T College of Engineering as Associate Professor and head of the department. He is a life member of ISTE. (pugazhifet@gmail.com)

U.Palani was born in Tamilnadu on 1979 received his UG degree in Electronics Engineering from Madras University in 2001 and PG degree from Vinayaga Mission University .His field of interest is Applications of Electrical and Electronics Engineering , Digital Electronics. He is having 10 years of teaching Experience. He is a Life member of ISTE.

S.Karthick was born on 1991 at Neyveli, situated in Tamilnadu , he had completed his Diploma in Electrical and Electronics Engineering in 2010 and at present he is pursuing his bachelor's degree in Electrical and Electronics Engineering department at IFET College of Engineering, Villupuram, Tamil Nadu. He published one national journal. His areas of interests are power electronics, Power quality issues, computer networks and electrical machines. He is a member of ISTE .

P.Arulkumar was born on 1991 at Neyveli, situated in Tamilnadu , he had completed his Diploma in Electrical and Electronics Engineering in 2010 and at present he is pursuing his bachelor's degree in Electrical and Electronics Engineering department at IFET College of Engineering, Villupuram, Tamil Nadu. . His areas of interests are Power quality issues, and electrical machines.