International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 08 Issue: 06 | June 2021 www.irjet.net p-ISSN: 2395-0072

DOMESTIC SUPPLY INTEGRATED WITH SOLAR WATER PUMPING SYSTEM FOR AGRICULTURE APPLICATION

SILAMBARASAN.E [1], MOHANKUMAR.G[2]

[1]*P.G Scholar, Department of EEE, PRIST UNIVERITY, Thanjavur, Tamil Nadu (Puducherry Campus)*

[2]*Assistant Professor& Head, Department of EEE, PRIST UNIVERITY, Thanjavur, Tamil Nadu (Puducherry Campus)*

Abstract – *In this paper domestic supply integrated with solar PV fed water pumping system for agricultural application which is driven by a brushless DC (BLDC) motor is designed. The worldwide energy crisis in near future thanks to the rapid depletion of conventional fuel resources and a consistently diminishing costs of solar photovoltaic (PV) modules, motivate towards an efficient utilization of solar PV technology. The solar photovoltaic generates power employing maximum power point tracking (MPPT) technique. This power conversion stage result in an increased cost, size, complexity and reduced efficiency. A one stage solar PV energy conversion system feeding a BLDC motor-pump which eliminates the DC-DC conversion stage. The suitability of proposed system is validated through its performance and evaluation using MATLAB/Simulink.*

Key Words: MPPT, Solar PV array, BLDC motor, Water pump

1.INTRODUCTION

Agriculture (17.2%) is one of the main contributors which is profoundly reliant on monsoons. Due to uncertain rainfall Gross Domestic Product (GDP) of India is found to be decreasing continuously. More than twenty million water pumps are installed within the country to satisfy the need of water, which consumes approximately 92 billion units of energy once a year (22% of the country's electricity consumption). Water demand is generated using fossil fuels to satisfy this most of the energy consumed (67 billion units of 92 billion units). Using fossil fuel result in increased GHG emission, resulting to global warming due to Conventional WPSs driven Motor. The disadvantage of using above methods are like frequent power cuts/outages, Motor burnouts, Transmission, distribution losses, poor power quality of the grid and maintenance due to grid voltage variations. Using renewable sources efficiently to satisfy energy demands is that the solution to the present problem. The continual reduction within the cost of PV modules, the advancement in power electronics and computing technologies has attracted many researchers to innovate and supply efficient renewable energy used system.

Among the various applications of solar PV system, the foremost promising and attractive in various areas like rural farm irrigation, urban street watering and fish farms, a standalone PV powered water pumping system seems to be suitable. Utilization of electrical motors have exponentially need for electricity within the modernization of human community. A motor plays prominent role (more than 40% of overall electrical power expenditure) therefore, to understand an economical water pumping and solar PV based energy efficient. An efficient motor drastically minimizes the number of solar modules for a given power demand and hence it's cost of capital. The DC motor with brushes possesses a low efficiency and it requires regular maintenance due to the sliding brush contacts and therefore the commutator. An induction motor based PV pumping system is reliable, rugged and maintenance-free with better efficiency and offers more flexibility for control as compared to DC motors.

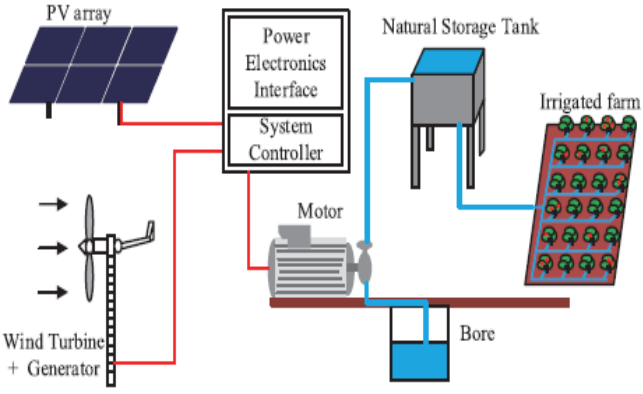


Figure 1 Renewable Energy based Water Pumping System.

2. PROPOSED SYSTEM CONFIGURATIONAND SENSORLESS CONTROL

A single stage solar PV energy conversion system supported brushless DC motor-water pumping as shown in figure 2. The BLDC motor-pump during which solar PV array is directly connected to a VSI. The flows of reverse current within the PV array are often controlled by means of diode

connected serial. Power transfers from PV array to the BLDC motor-pump are enabled by means of small DC link capacitor. Optimum utilization of solar PV array is often through with the assistance of incremental conductance MPPT technique. This technique uses PV voltage and current because the feedback signals to get an optimum duty ratio, like the utmost power of solar PV array.

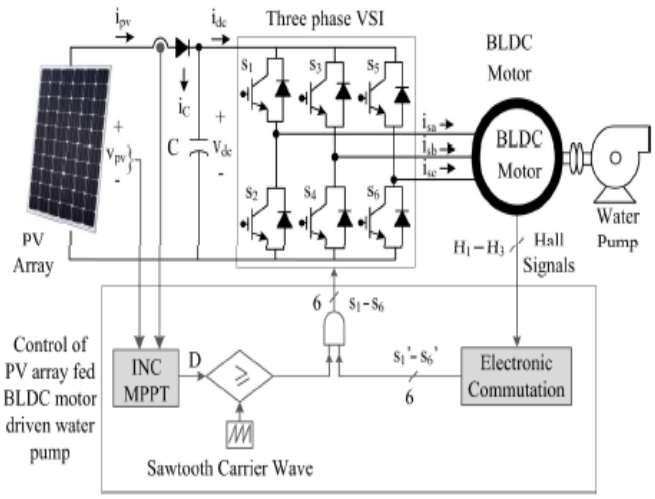


Figure 2 Single stage solar PV energy conversion system.-Proposed water pumping

Advantages of BLDC motor-based drive over induction motor-based water pumps are:

1) Power conversion efficiency is higher compared to an induction motor drive.

2) Overall system Cost is minimum with reduced PV array size.

3) Power factor of BLDC motor is higher in comparison with Induction motor drive.

2.1 MPPT OPERATION

Figure 2 shows that for achieving the MPPT operation, the dc-link current I_{dc} and voltage V_{dc} are sensed, which are wont to measure the input power. The triggering instants are generated from the MPP voltage is given by the MPPT block, which is set supported the available PV power. Additionally from MPPT block the PWM signals and therefore the duty ratio D are generated.

2.2 Sizing of PV Array

Under the quality test conditions, solar irradiation of 1000 W/$m2$ is achieved. The highest power rating of the PV array is set considering the losses within the motor, inverter and deviations from the STC.

3. SIMULATIONS AND RESULTS

The proposed systems are simulated in the MATLAB/Simulink platform and therefore the results obtained are presented in figure 4.

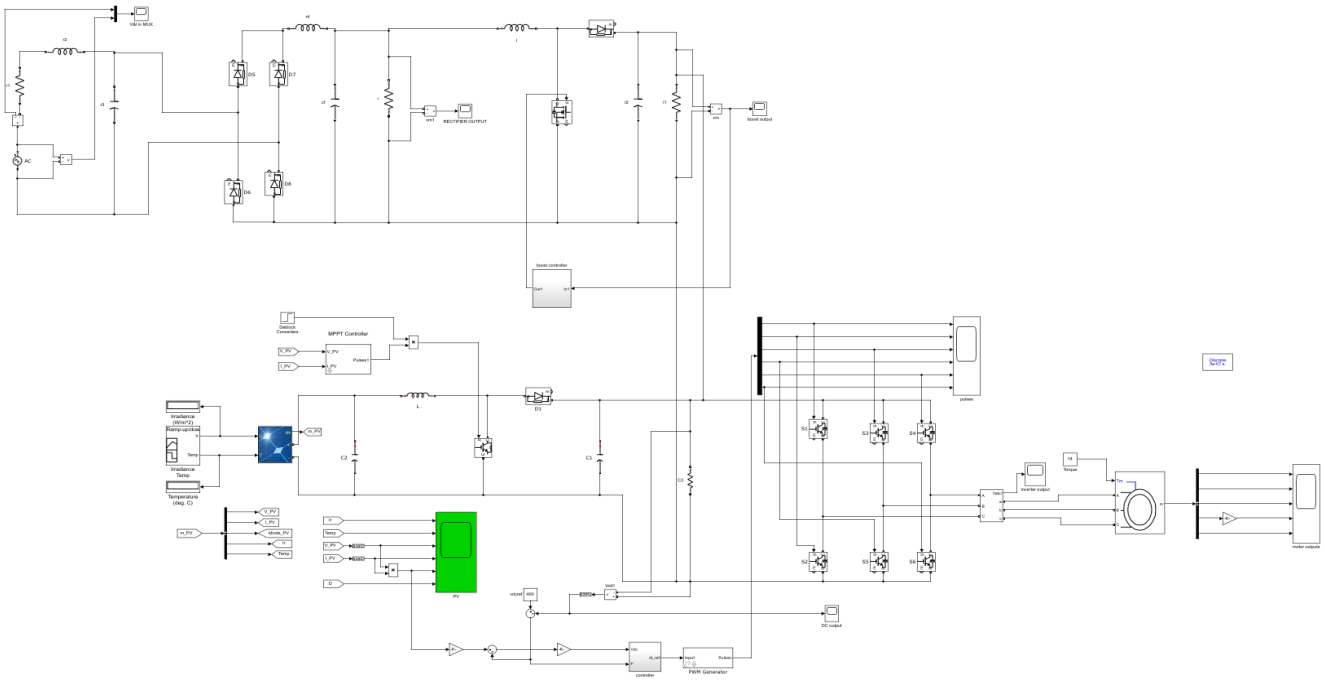
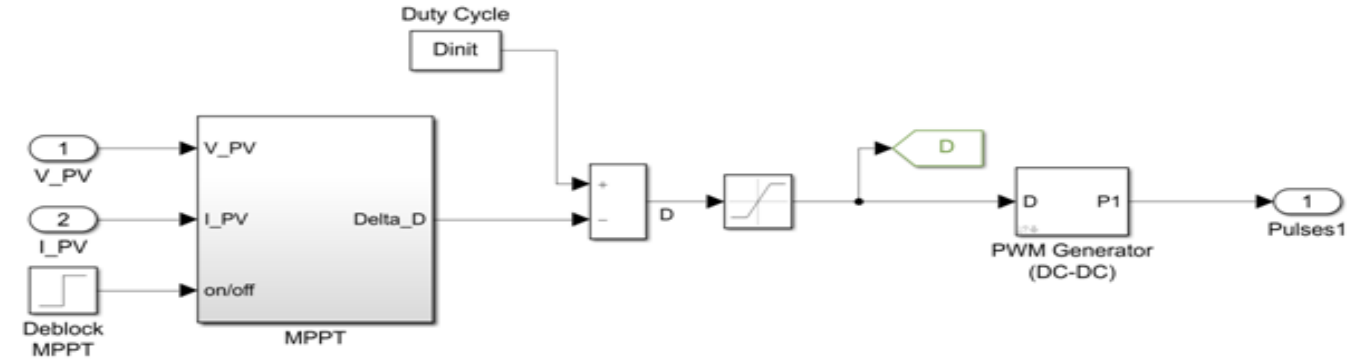
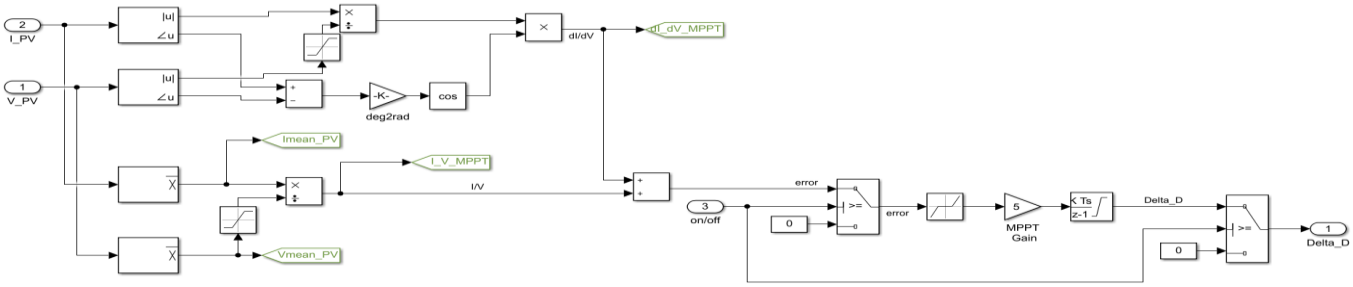


Figure 3 Proposed system with Solar PV/Wind with BLDC motor



(a)



(b)

Figure 4 (a) & (b) MPPT Controller configuration

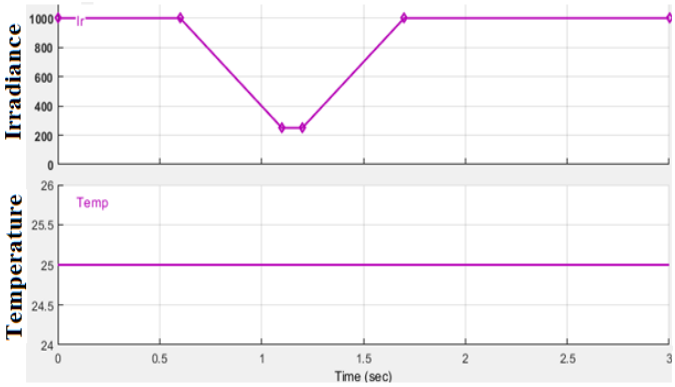


Figure 5 Solar Irradiance and Temperature

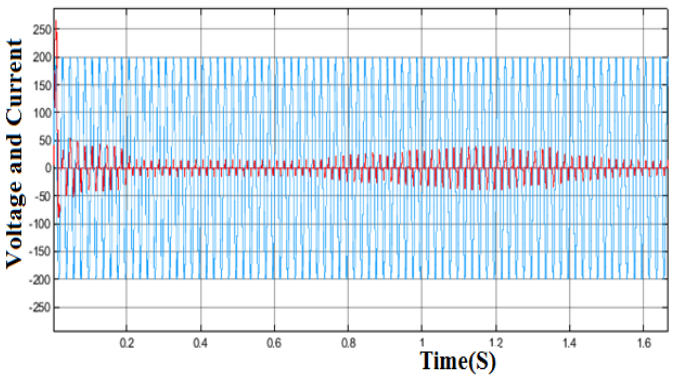


Figure 6 Input Voltage and current

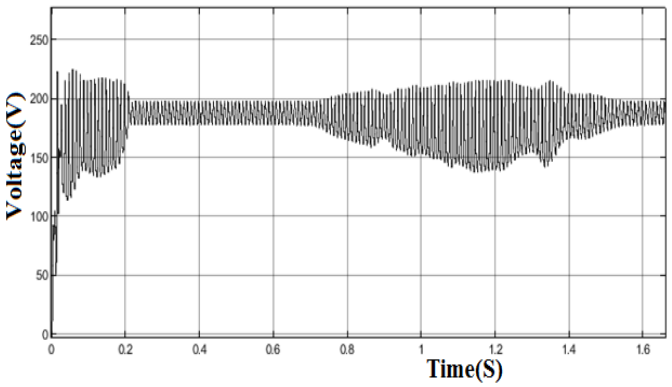


Figure 7 Rectified Output Voltage

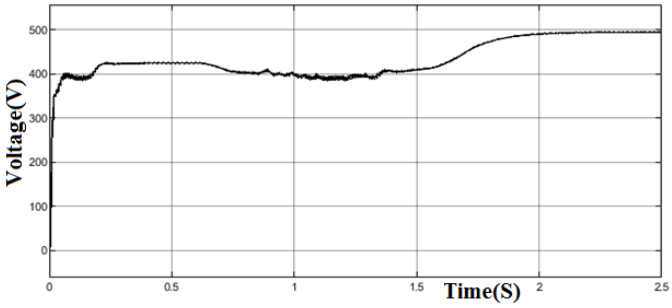


Figure 8 Boost Output Voltage

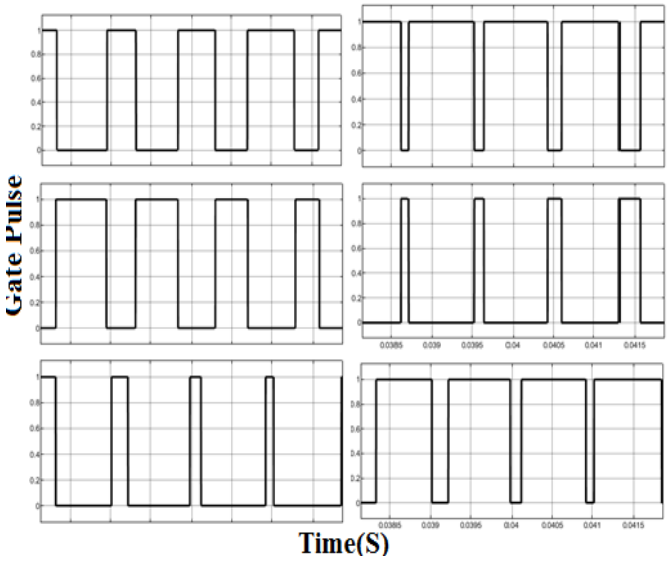


Figure 9 Gate Pulse

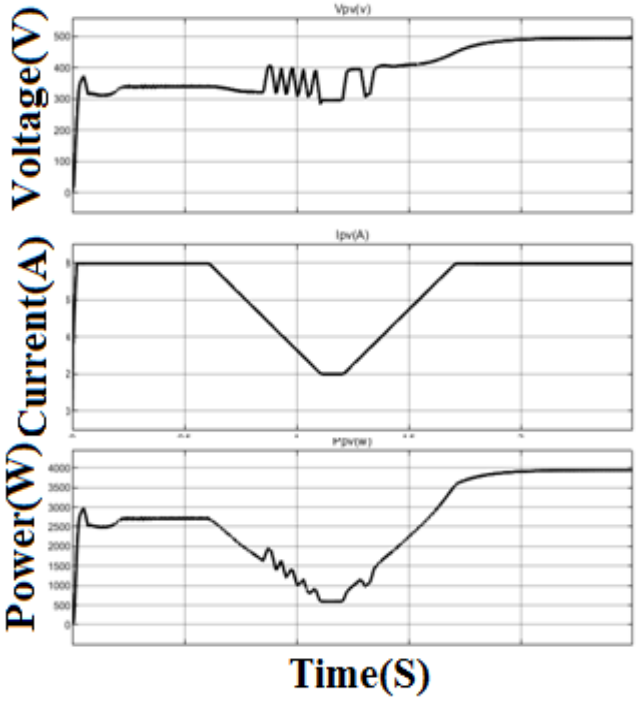


Figure 10 Solar output voltage, current ,power

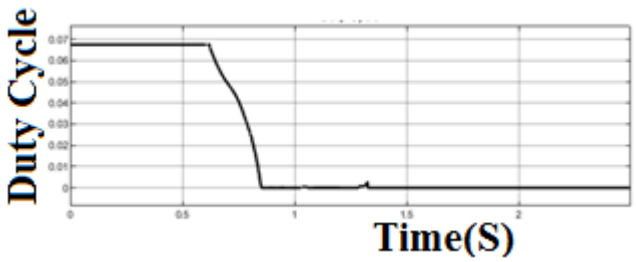


Figure 11 Duty Cycle to MPPT

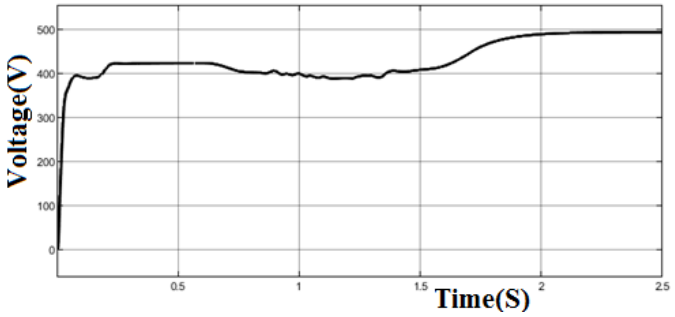


Figure 12 Output Voltage

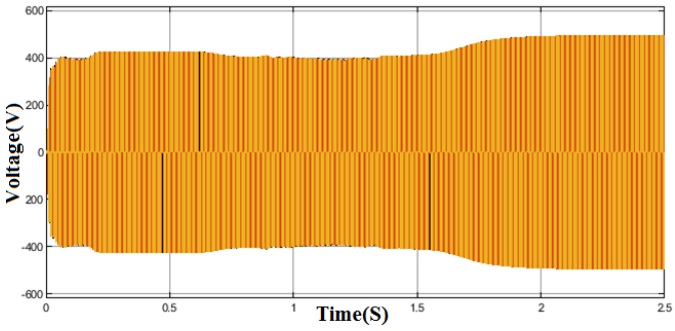


Figure 13 Inverter Output Voltage

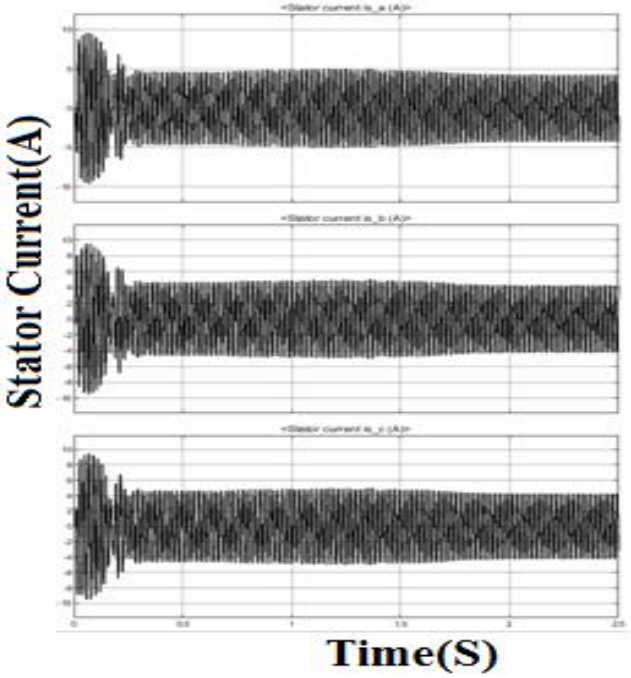


Figure 14 Motor Stator Output current

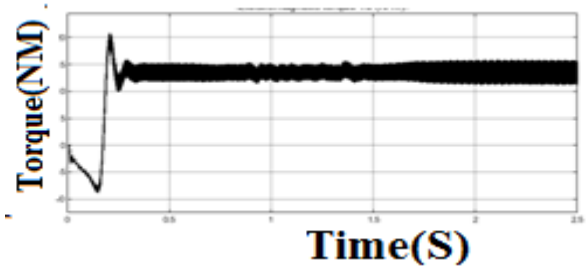


Figure 15 Motor Torque

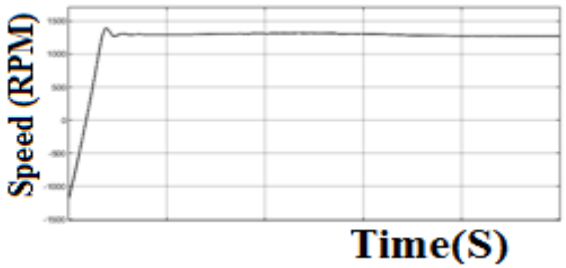


Figure 16 Motor Speed

4. CONCLUSION

In this paper domestic supply integrated with solar PV fed water pumping system for agricultural application which is driven by a brushless DC (BLDC) motor was designed and simulated using MATLAB/SIMULINK and the corresponding outputs are obtained. The proposed topology provides a converter less solution for solar fed BLDC driven pumping. The sensorless control method incorporated within the drive system achieves high performance.

REFERENCES

[1]S. Sashidhar, V. Guru Prasad Reddy and B. G. Fernandes, "A Single- Stage Sensorless Control of a PV-Based Bore-Well Submersible BLDC Motor," in IEEE Journal of Emerging and Selected Topics in Power Electronics, vol. 7, no. 2, pp. 1173-1180, June 2019.

[2] S. Sashidhar and B. G. Fernandes, "A novel ferrite SMDS spoke-type BLDC motor for PV borewell submersible water pumps," IEEE Trans. Ind. Electron., vol. 64, no. 1, pp. 104–114, Jan 2017.

[3] Y. Zhou, D. Zhang, X. Chen, and Q. Lin, "Sensorless direct torque control for saliency permanent magnet brushless dc motors," IEEE Trans. Energy Convers., vol. 31, no. 2, pp. 446–454, June 2016.

[4] F. Verbelen, S. Derammelaere, C. Debruyne and K. Stockman, "A general model for 6 switch voltage source inverter," 2014 16th European Conference on Power Electronics and Applications, Lappeenranta, pp. 1-6, 2014.

[5] S. K. Awaze, "Three-Phase Inverter Fed BLDC Motor Drive," 2012 International Conference on Communication Systems and Network Technologies, Rajkot, pp. 838-842, 2012.

[6] M. Jacob and V. Aishwarya, "Sensorless brushless DC motor drive fed by Cuk converter," 2016 International Conference on Circuit, Power and Computing Technologies (ICCPCT), Nagercoil, pp. 1-7, 2016.

BIOGRAPHIES

E.SILAMBARASAN received his B.E degree in electronics and communication engineering from the Anna University, Chennai, Tamilnadu in 2007.From 2012 to 2017 worked as Assistant Engineer in Operation & Efficiency in North Chennai Thermal Power Station in TNEB. From 2018 to till now working as Assistant Engineer/O&M/Veedur in TNEB working hard. He is specialization in TNEB is operation and Maintenance in Distribution Network dealt upto 110KV.