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Comparative Analysis PI and Sliding Mode Control for Transformer less Grid Connected Inverter using PV System

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ABSTRACT: The continuous urge for improvement in our standard of living has increased the consumption of electrical energy by leaps and bounds. This hike in energy consumption, draining of fossil fuels and degrading global environment has led to invention of green power generation systems. Thus, the global demand for renewable resources has led to flourishing of photovoltaic (PV) market. The enabling technology in the PV systems is the inverter, which could be either: 1) with transformer isolated or 2) without transformer non-isolated (transformer-less inverter). Recently, single phase transformerless voltage source inverters (VSI) have been extensively used for distributed photovoltaic grid tied systems. The objective of this paper is to review a few notable topologies and propose a new topology for transformer-less photovoltaic inverter. The analysis and design of the proposed topology is verified by simulating it on PSIM. Furthermore, the simulation results are validated by testing a proof-of-concept laboratory hardware prototype rated at 250 W. Keywords— Photovoltaic (PV) systems, transformer-less, single phase inverter.

KEYWORDS: Photovoltaic (PV), Transformer less, Inverter

I. INTRODUCTION

The increasing population and restricted amount of conventional natural resources like fossil fuels has made it necessary to obtain energy from unconventional sources, especially like the sun as it is unlimited, free and lacks any contaminants. With help from government incentive scheme and decrease in charges of photovoltaic (PV) module play a vitally important in distributed power generation. The evaluation of the grid-tied PV systems is enhanced by the progress in power convertors. In present two kinds of grid connected PV systems are available: one that uses a transformer and the other that does not. For security purpose with galvanic isolation, most of PV systems are built-up with transformer. Because of galvanic isolation, DC current does not inserted into grid. The current leakage within PV system and power grid is reduced by galvanic isolation. The high-frequency power transformer is used on DC side and at inverter's output side low frequency power transformer is used. The transformers costly though and also decrease the total frequency of the cycle of power conversion. Transformer-less (TL) PV system is provided to resolve these difficulties and is slightly lighter, inexpensive and high efficiency developed [7]. There is shortage of natural sources such as fuel and coal whereas on the other side there is rapid increment in human population [13]. To address this issue a best and genuine natural option is solar energy which is free from pollution. Grid linked with PV system play main rolein distributed (DB) power generation because of low price of photovoltaic module and more number of government incentives.

Apart from these factors, progress in power electronics and semiconductor technology help in development of grid connected PV systemThe energy amount and payback time are totally dependent on reliability and efficiency of inverter, in case of PV systems that are grid connected In the approach we have taken, unipolar pulse width modulation control is used by transformer-less PV inverter because which ground leakage current is reduced and efficiency is increased [6]. In this project, analysis, modeling, simulation and implementation of the closed loop operation of a novel inverter topology suitable for transformer-less grid connected application is presented. The advantages of the proposed inverter topology are: (i) Elimination of ground leakage current; (ii) Buck-boost capability; (iii) Long operational life; (iv) Extraction of maximum power from PV array; (v) Low THD of the output current and (vi) Low dc injection into the grid. The effectiveness of the proposed inverter topology is verified with the help of simulations. Modeling of the

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inverter, small signal analysis (SSA), controller design, MPPT and Phase Locked Loop (PLL) using inverse Park transformation will be simulated in MATLAB which is slightly worse than that of the H5 topology, but it features higher efficiency than that of H5 topology

II. PROBLEM FORMULATION

A. *Existing System*

Exiting system with H5 transformer less system available but is the most versatile device. In summary, the H5 topology has the best leakage current characteristic, but its efficiency is the lowest. The H6 topology has the best performance about leakage current suppression in existing single-phase full-bridge transformer see topologies but high leakage current.

B. Proposed System

In this project, analysis, modeling, simulation and implementation of the closed loop operation of a novel inverter topology suitable for transformer-less grid connected application is presented. The advantages of the proposed inverter topology are: (i) Elimination of ground leakage current; (ii) Buck-boost capability; (iii) Long operational life; (iv) Extraction of maximum power from PV array; (v) Low THD of the output current and (vi) Low dc injection into the grid.. The efficiency of presented TL inverter is more by comparing with existing TL inverter.

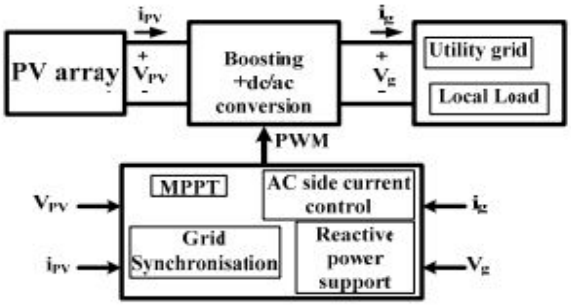

Fig.1.Proposed Topology

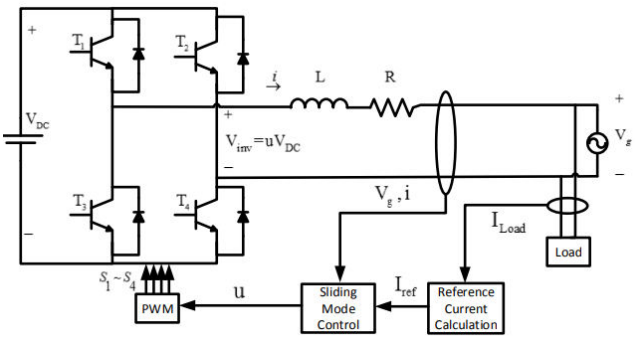

Fig.2. sliding mode control

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III. PROBLEM FORMULATION

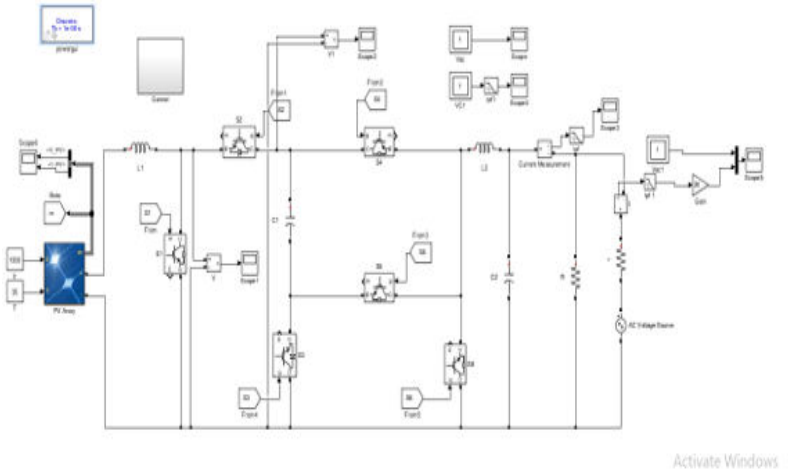

Fig 3. Simulation using PI control

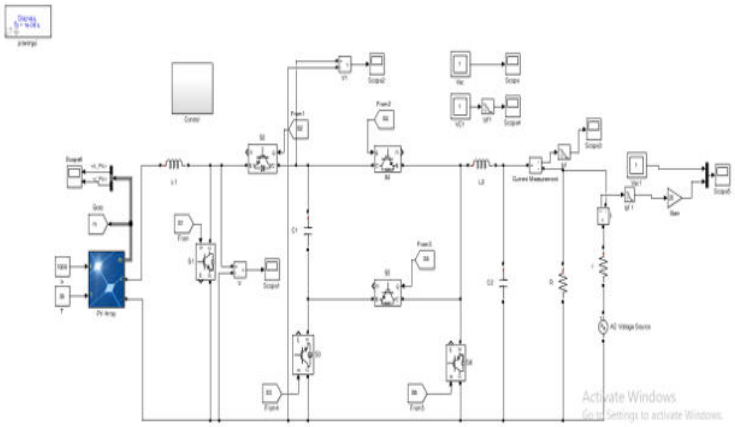

Fig 4. Simulation using simulation sliding mode

IV. RESULT

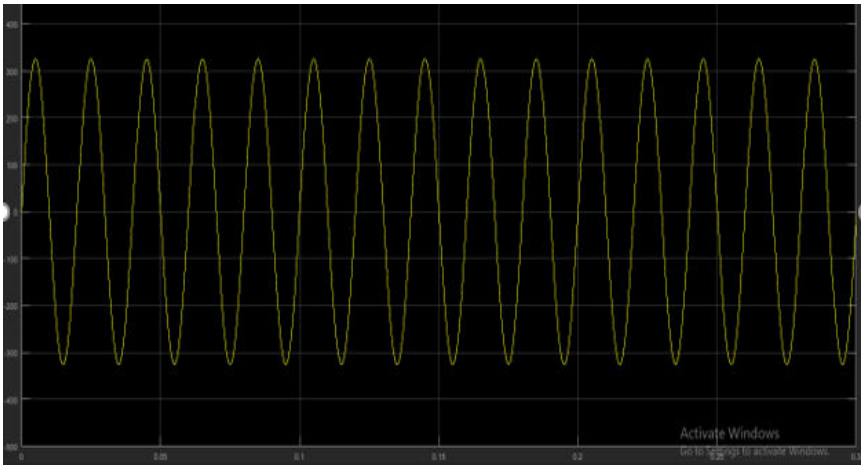

Fig:5 Output Voltage of inverter

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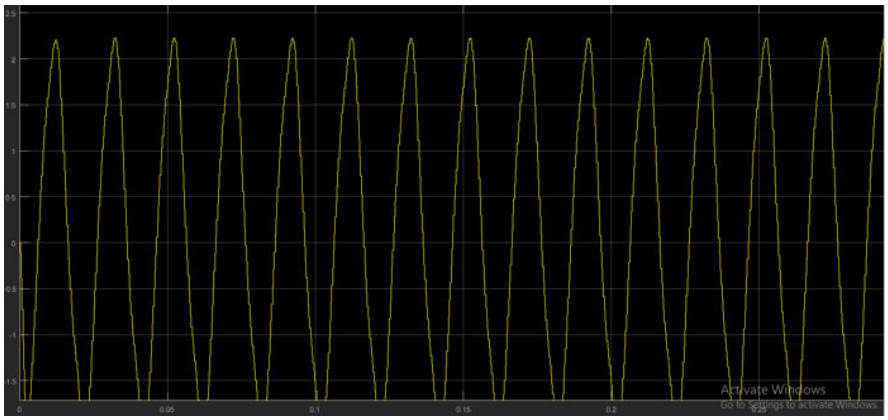

Fig:6 Output Current of inverter

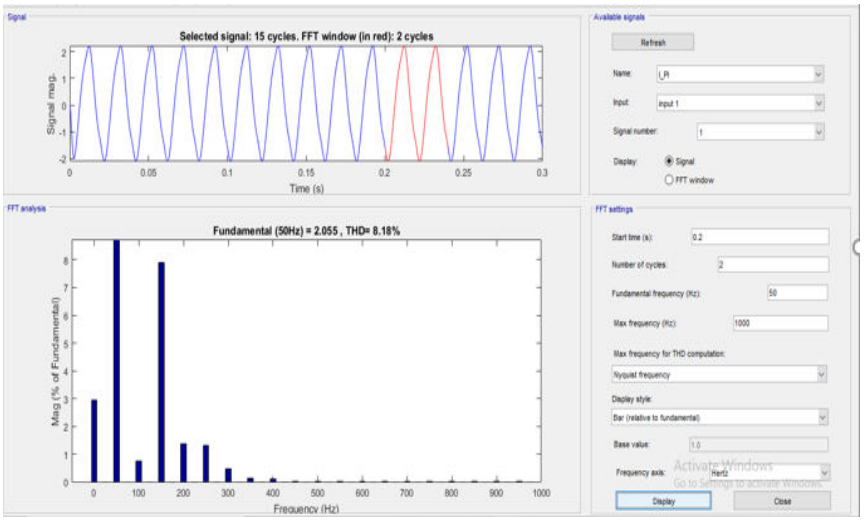

Fig: 7Total Harmonic Distrotion show 8.18% using PI controller

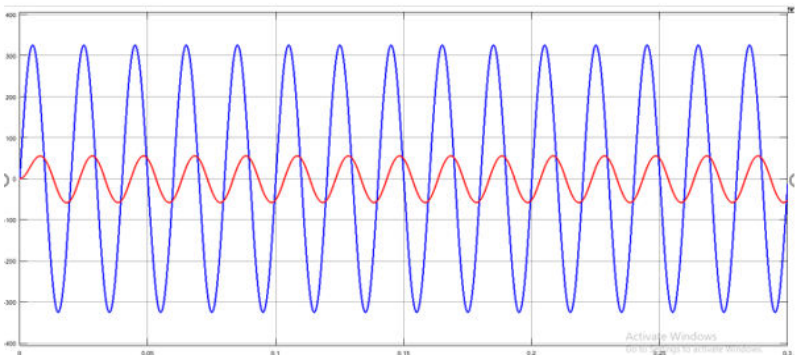

Fig :8 Utility grid voltage and current Traditional Method

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Following result show using sliding mode control

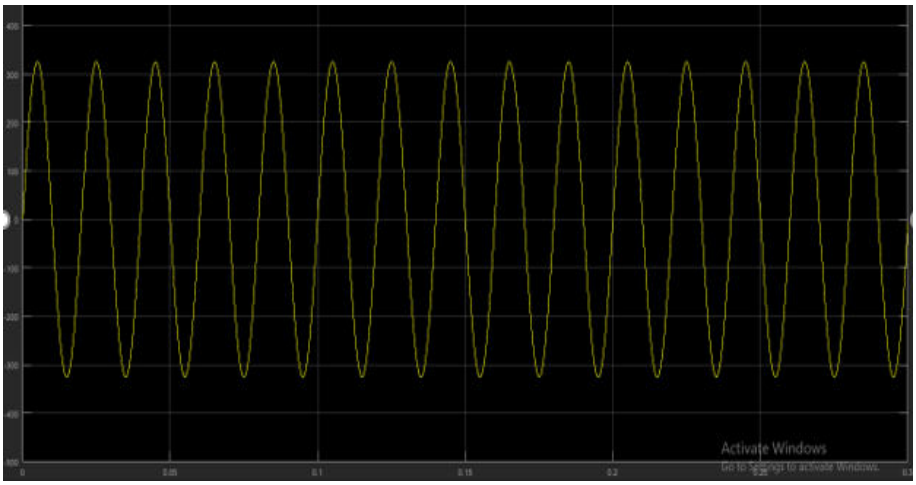

Fig:9 Output Voltage of Inverter

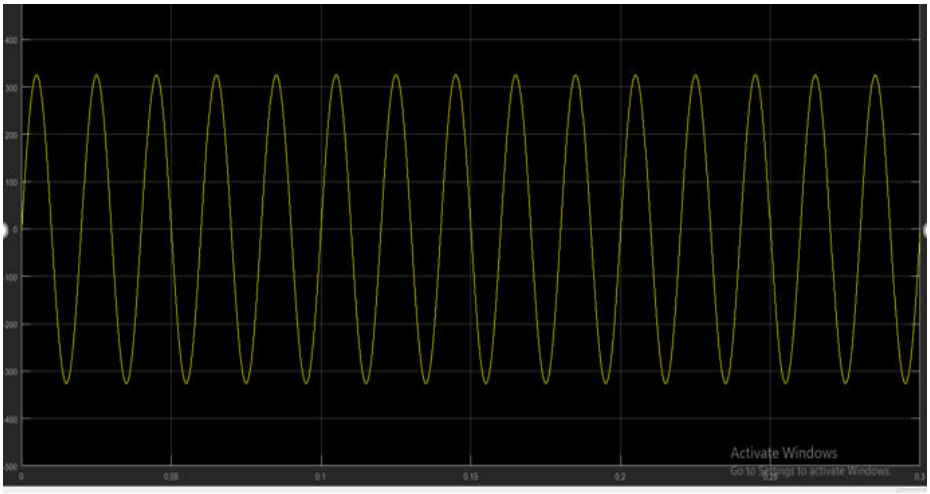

Fig:10 Output Current of Inverter

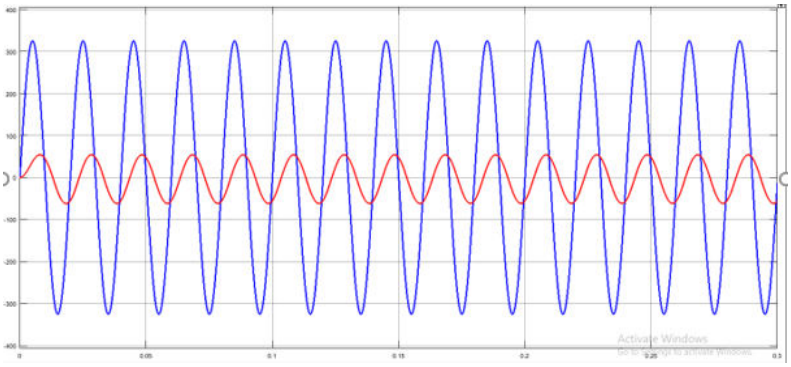

Fig:11 Utility Grid voltage and Current

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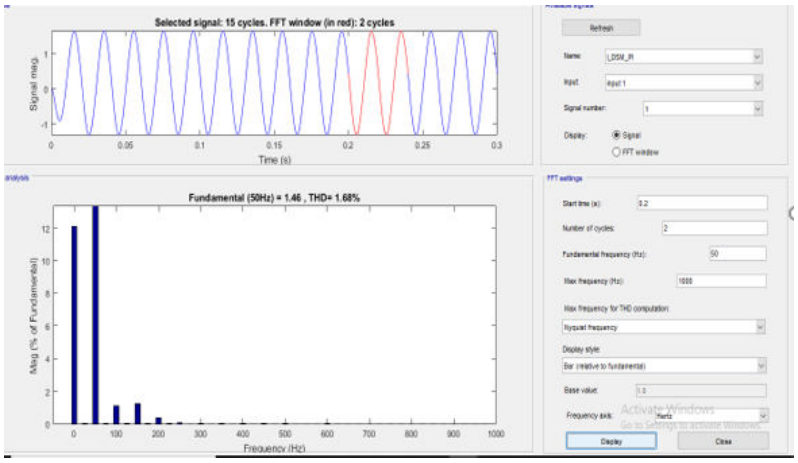


Fig.12 THD using Sliding mode show 1.18%

V. CONCLUSION

The work will presents a new high efficiency transformer-less inverter for grid tied PV systems. The key benefits of this research work in brief as:

1. Proposed converter will the overall efficiency.
2. By keeping common mode voltage fixed at center point of bus DC voltage due to this less leakage current will flow through the network than H6 topology.
3. The illustrated work, which minimizes THD at output side, does not require PWM dead time.

bridge legs.

REFERENCES

[1] L. Zhang, K. Sun, Y. Xing and M. Xing, "H6 Transformerless Full-Bridge PV Grid-Tied Inverters," in IEEE Transactions on Power Electronics, vol. 29, no. 3, pp. 1229-1238, March 2014, doi: 10.1109/TPEL.2013.2260178.

[2] L. Zhang, K. Sun, Y. Xing and M. Xing, "H6 Transformerless Full-Bridge PV Grid-Tied Inverters," in IEEE Transactions on Power Electronics, vol. 29, no. 3, pp. 1229-1238, March 2014, doi: 10.1109/TPEL.2013.2260178.

[3] H. Wang, S. Burton, Y. Liu, P. C. Sen and J. M. Guerrero, "A systematic method to synthesize new transformer less full-bridge grid-tied inverters," 2014 IEEE Energy Conversion Congress and Exposition (ECCE), Pittsburgh, PA, 2014, pp. 2760-2766, doi: 10.1109/ECCE.2014.6953772.

[4] Y. Dai, W. Li, C. Zhou and S. Zhuang, "Research on transformerless dual-buck full-bridge grid-connected inverter with H5-type for PV systems," in IET Power Electronics, vol. 12, no. 1, pp. 44-50, 12 1 2019, doi: 10.1049/iet-pel.2018.5196.

[5] J. Fang, M. Shi, H. Xiao and R. Wang, "A Zero-Voltage-Transition H5-Type Transformerless Photovoltaic Grid-Connected Inverter," in IEEE Access, doi: 10.1109/ACCESS.2019.2946976.

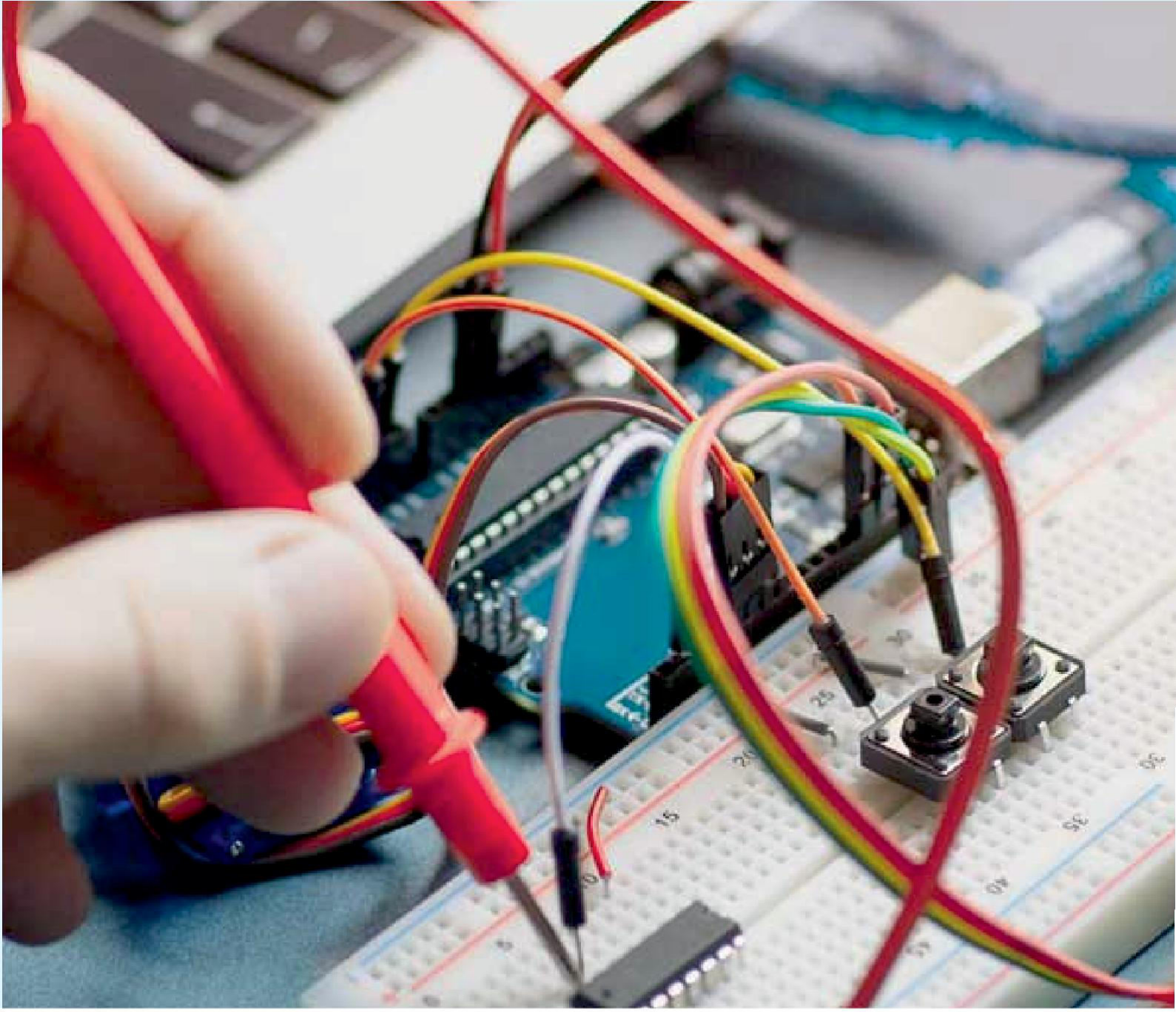
[6] M. Islam, S. Mekhilef, and M. Hasan, "Single phase transformerless inverter topologies for grid-tied photovoltaic system: A review," Renewable and Sustainable Energy Reviews, vol. 45, pp. 69-86, 2015.

[7] Yong-Won, C., Woo-Jun, C., Jung-Min, K., et al.: 'Improved single-phase TL inverter with high power density and high efficiency for grid-connected photovoltaic systems', IET Renew. Power Gener., 2016, 10, (2), pp. 166–174 [15] Li,

[8]W., Gu, Y., Luo, H., et al.: 'Review and derivation methodology of single phase TL photovoltaic inverters for leakage current suppression', IEEE Trans. Ind. Electron., 2015, 62, (7), pp. 4537–4551.

[9] Jaber, F.A., Yam, P.S., Mehran, S., et al.: 'S4 gridconnected single-phase TL inverter for PV application'. IEEE Conf., 2016

[10] Yong-Won, C., Woo-Jun, C., Jung-Min, K., et al.: 'Improved single-phase TL inverter with high power density and high efficiency for grid-connected photovoltaic systems', IET Renew. Power Gener., 2016, 10, (2), pp. 166–174.



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