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A Boost Converter for Renewable Energy Sources

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***Abstract*— This paper proposes a isolated multi-input single output dc-dc boost converter for instantaneous regulation of power from different renewable input energy sources having different capabilities. The proposed boost converter integrates only one controllable switch to each input renewable energy source which show the way to simple topology and use of minimum number of switches in it. Two photovoltaic (PV) panels, two wind turbine generators (WTG's) and one isolated output port are interfaced to the boost converter. This converter is then applied to the maximum power point tracking (MPPT) by which maximum power point will be tracked at any particular instant of given time. The experimental simulation results are presented to authenticate the effectiveness of the proposed converter.**
***Keywords*— Solar energy, wind energy, multiport dc-dc converter, maximum power point tracking (MPPT), power management.**

I. INTRODUCTION

With increasing short fall of fossil fuels, climate change and severe damage to the environment, renewable energy sources such as solar energy, wind energy, tidal energy has gained an interest as an alternative energy sources [5], [6]. However, solar energy and wind energy have disadvantage that they are less accurate in nature. For example, solar energy is efficient during day time and becomes inefficient during night time or during cloudy weather. In case of wind energy, it is more efficient during night time than during day time. So, if both of these systems are hybridized then the overall output will become efficient. By interfacing more number of renewable energy sources with a DC bus comparing with Ac type power transfer has been widespread so that it becomes easy in check and control and easy to understand in structure.

Hybridization of these sources can be interfaced with multiport dc-dc converter. There are several converters such as buck converter, boost converter, buck-boost converter, etc. Boost converter has been proposed in this project which converts a low level dc voltage dc level to a high level dc voltage. This converter has the least number of switches as compare to the conventional converter in which more numbers of switches were used and this converter has an advantage of having lower cost [1]-[4]. Moreover the proposed converter is applied for power regulation of a wind/solar hybrid generation systems, which consists of two WTG's and two photo voltaic (PV) panels. The power generation from solar and wind energy are designed using perturbation and observation (P&O) MPPT algorithm, in which the power of WTG and PV panels can be controlled at the same instant of time and extract the maximum power.

II. PROPOSED MULTI INPUT DC-DC CONVERTER

Fig.1 shows the block diagram of the proposed boost converter which consists of two PV panels, two wind turbine generators (WTG's), a boost converter, a high frequency transformer and an MPPT controller for maximum power tracking and a LC filter to eliminate the ac ripples present at the dc output.

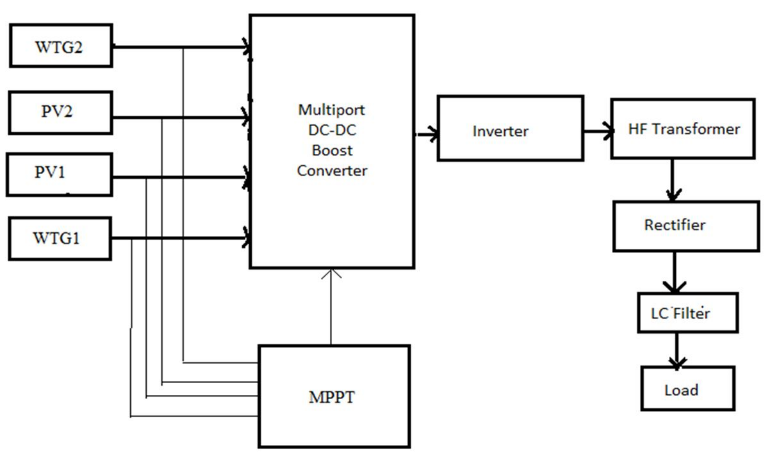

Fig.1 Block diagram of proposed system.

Here converter is isolated by which, if source is affected then load will not be affected and if load is affected then source will not be affected. Now, as explained earlier the converter is applied for MPPT control of a wind/solar hybrid generation system consisting of two WTG and two PV panels, as shown in Fig.1. The MPPT controller uses a P&O MPPT algorithm to track the maximum output power of the WTG and two PV panels simultaneously under various weather conditions.

Since the wind flow changes more severely than the solar irradiance and the temperature, the updating frequency of d1 (port1) is set to be the highest. The MPPT controller makes use of the output voltage and output current of every energy source as the input to produce a suitable pulse width modulated signal for the equivalent switch of the boost converter. Here MOSFETS are used as switches in the converter. The flowchart of the P&O MPPT algorithm is shown in Fig.2, where Vs (k) and Ps (k) are the sampled voltage and power of each source at the Kth step respectively, and d is a predefined perturbation value of the switch duty cycle in two successive switching periods. The revised or modified duty cycle causes a change in the input source current, which show the way to the variation of the output power of the source.

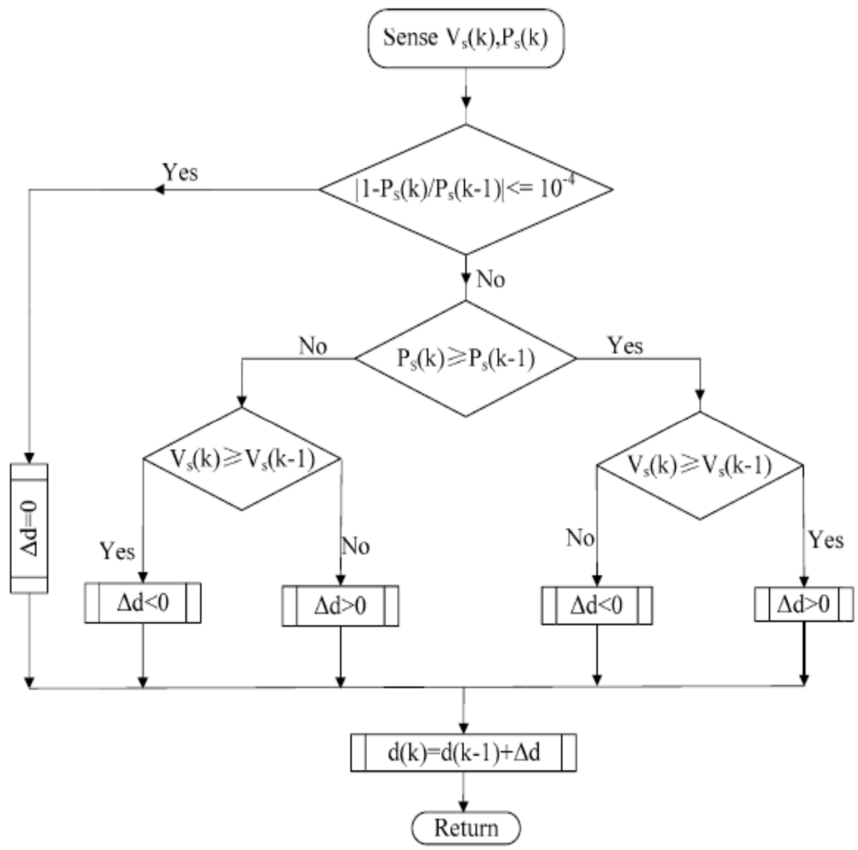

Fig.2 Flowchart of P&O MPPT algorithm.

As shown in above figure, the power variation and duty cycle perturbation in the previous step are used to establish the direction (i.e., positive or negative) of the duty cycle perturbation in the next step.

III. SIMULATION OF THE PROPOSED SYSTEM

To investigate the MPPT outcomes for the two PV panels and the WTG's it is required to obtain the idyllic maximum power points (MPPs) of the four sources under various circumstances. For the two photo voltaic panels, the power voltage (P–V) characteristics can be assumed unaffected within every 3 min interval in a clear day. Then, the maximum power point can be derived by progressively increasing the duty ratio from a low value to a high value. The maximum power point (MPP) of the WTG's can be computed using the measured wind speed. The Simulink model of the proposed isolated dc-dc converter is shown in fig 3.

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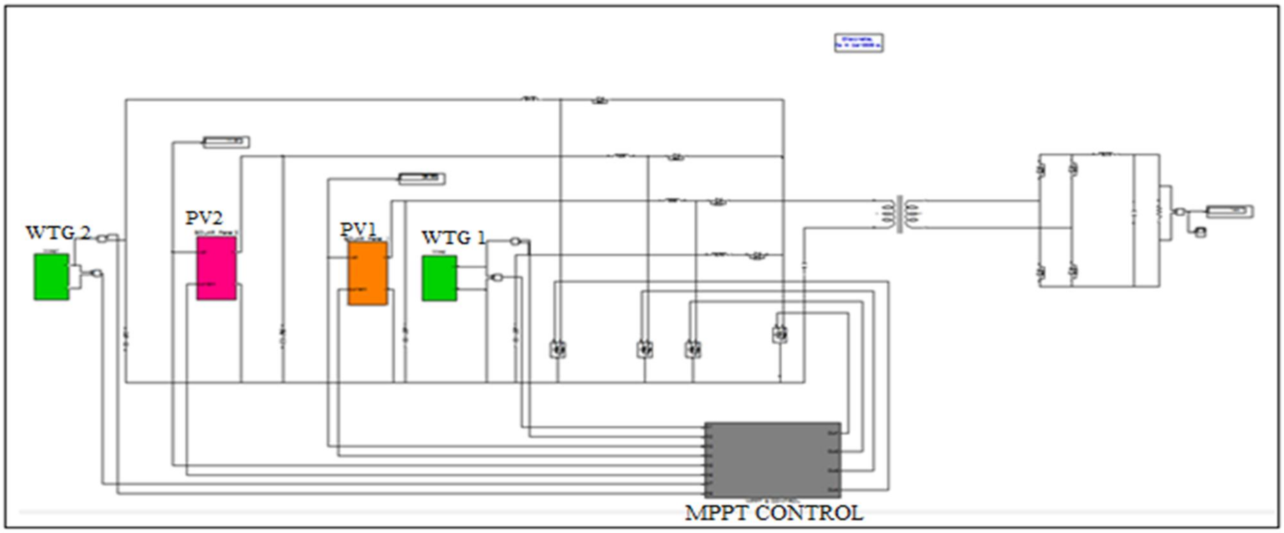

Fig3. Simulation circuit of the proposed system.

Fig. 3 shows the simulation circuit diagram of the proposed system in which the converter is interfaced with two PV panels, two WTG's followed by the rectifier and the load.

IV. SIMULATION RESULTS

The following results show the output voltages of PV panels, wind turbine generators and rectified DC output voltage.

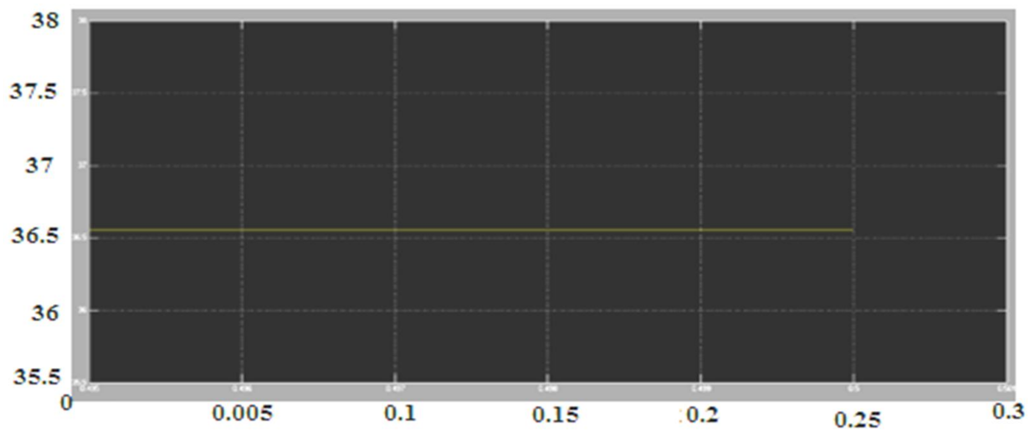

Fig4. Output voltage of PV1.

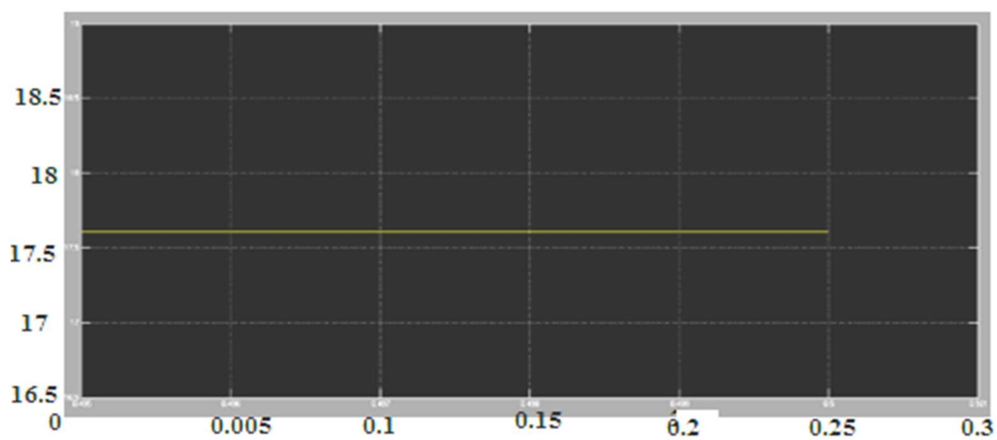

Fig5. Output voltage of PV2.

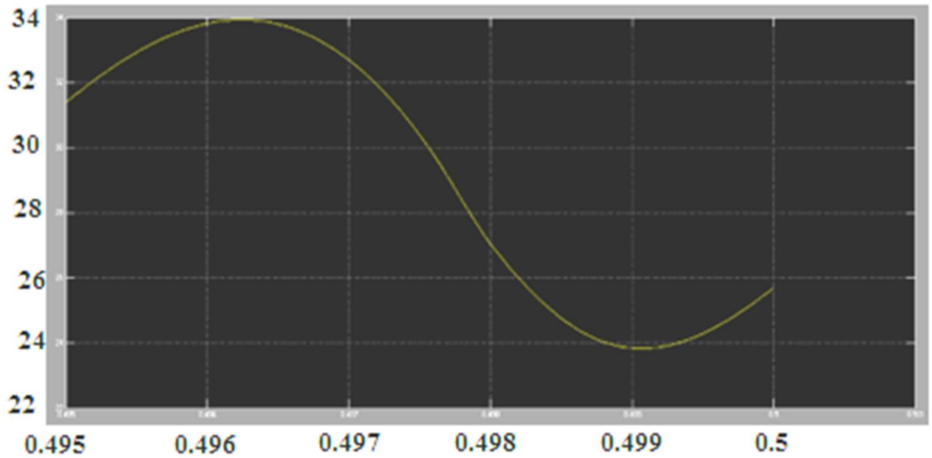

Fig6. Output voltage of WTG1.

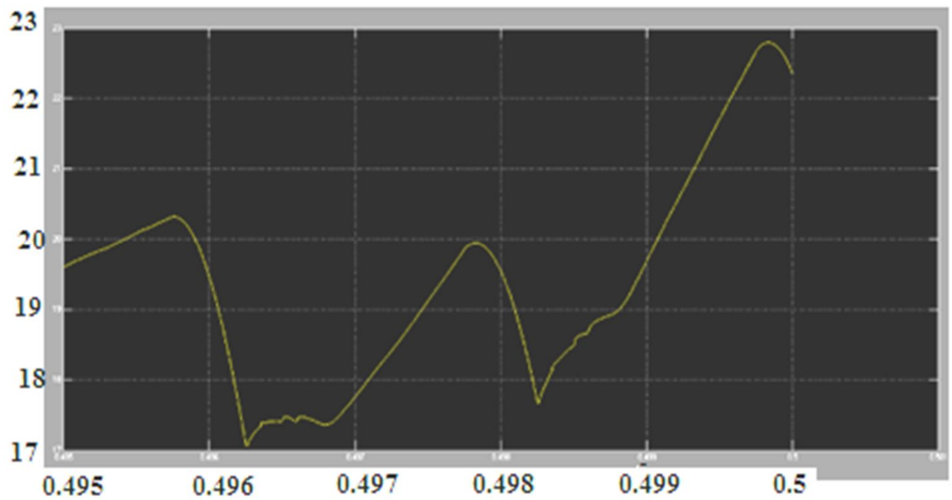

Fig7. Output voltage of WTG2.

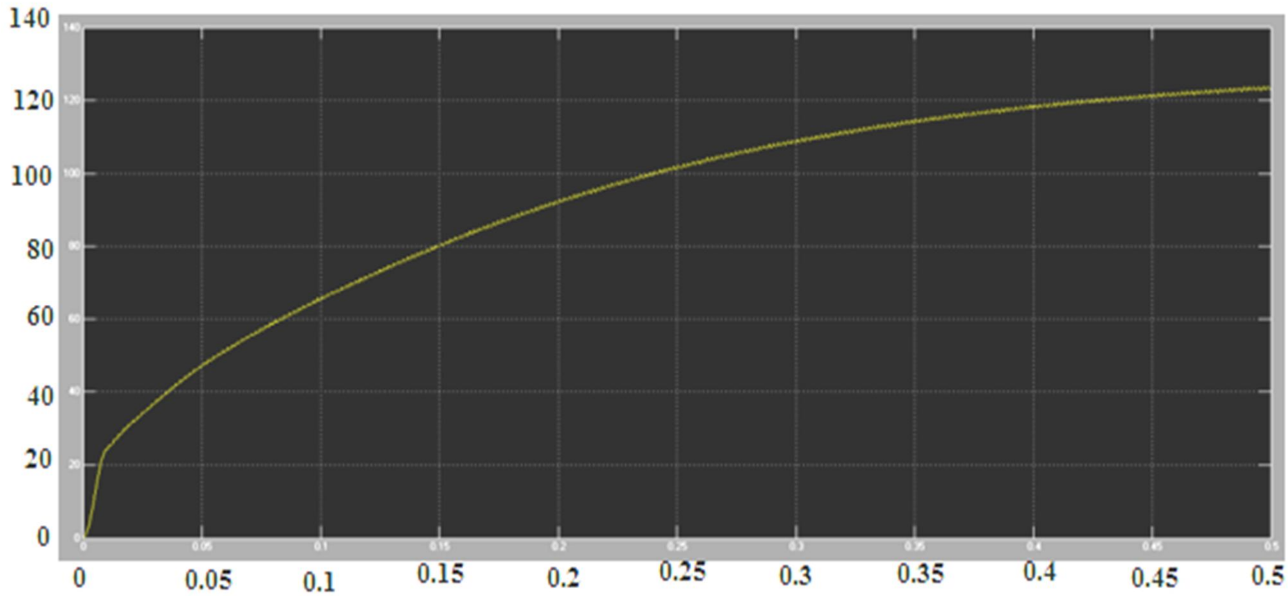

Fig8. Rectified dc output voltage.

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V. CONCLUSIONS

A multi input boost converter using minimum number of switches has been proposed for instantaneous power management of renewable energy sources. The four input sources have been applied for power management of wind/solar hybrid generation system. The experimental outcomes have been presented to show the validation of the converter. The output voltage is gradually increasing and becomes constant at approximately 123.1V, Output voltage of PV1 and PV2 is approximately 36.6v and 17.7v. The nature of output voltages of WTGs is fluctuating. The advantage of the converter is that it has the capability of MPPT control for different renewable energy sources concurrently. In future, the hybrid energy system can be additionally extended to some other renewable sources like PV-Fuel cell Hybrid Energy System to meet large load depending on an assortment of applications.

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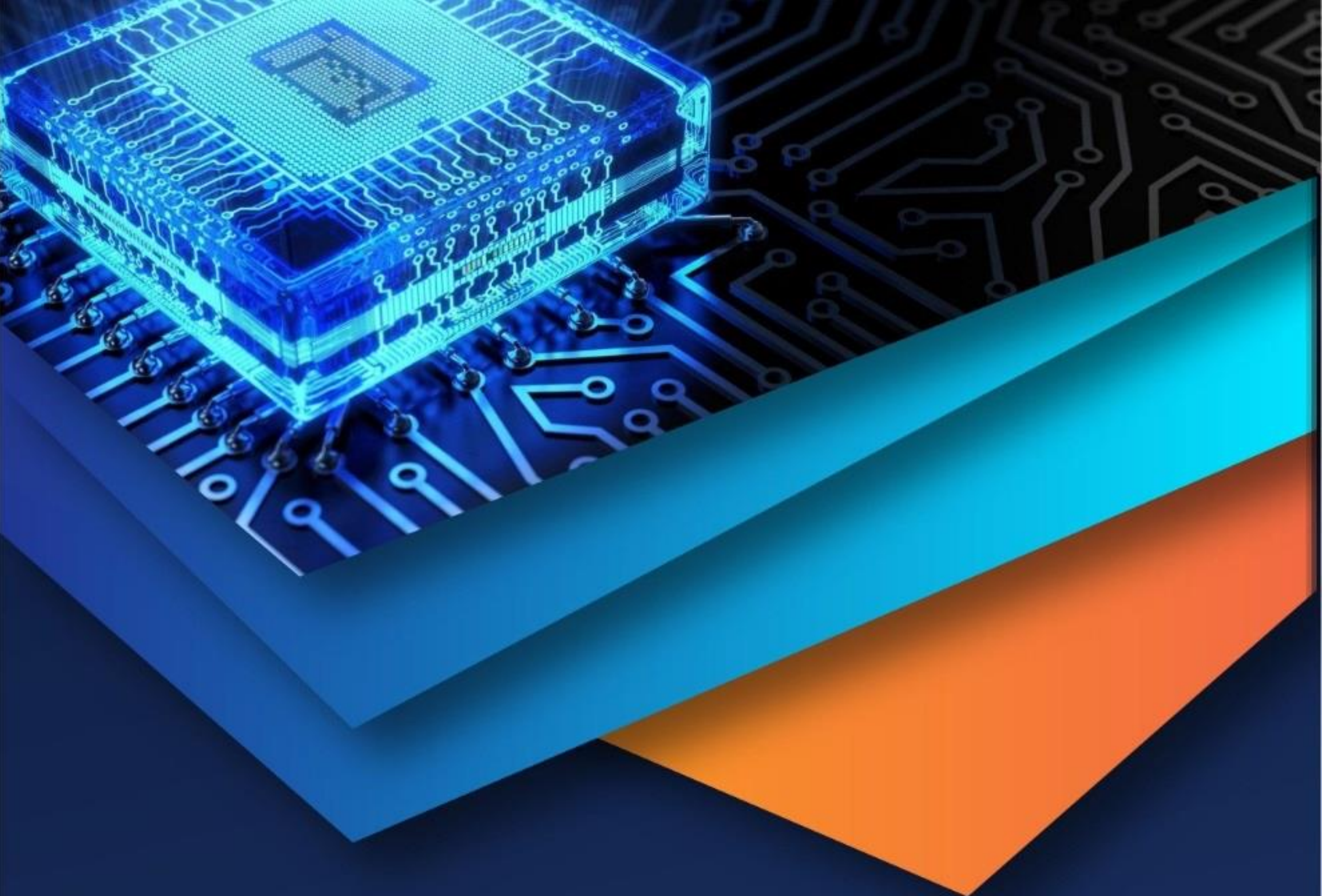

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