iJRASET
International Journal For Research in
Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 10 Issue: V Month of publication: May 2022

DOI: https://doi.org/10.22214/ijraset.2022.42567

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 10 Issue V May 2022- Available at www.ijraset.com

Fuzzy Logic Based MPPT Controller for a PV System

Mr. Nayan Navghare[1] , Mr. Saurabh Likhar[2], Mr. Ritik Sutey[3], Mr. Kundan Bhoyar[4], Mr. Adesh Bagde[5], Mr. Kaustubh Bagde[6]
[1, 2, 3, 4, 5, 6]*UG Student, Department of Electrical Engineering, G.H. Raisoni Institute of Engineering and Technology, Nagpur*

Abstract: Maximum Power Point Tracking (MPPT) for photovoltaic system has been developed to maximize the produced energy. The output power of a photovoltaic (PV) module depends on the solar irradiance and the operating temperature, therefore it is necessary to implement the maximum power point tracking controller to obtain the maximum power of a PV system regardless of variations in climatic conditions. The output characteristic of a photovoltaic array is nonlinear and changes with solar irradiation and the cell's temperature. Therefore, a Maximum Power Point Tracking technique is needed to draw peak power from the solar array to maximize the produced energy. In this work, the PV system is designed and simulated using MATLAB consisting of a solar panel array, MPPT controller, boost converter, voltage source convertor, a resistive load and grid. This thesis proposed the design and modeling of a fuzzy controller for tracking the maximum power point of a PV system. The performances of the solar PVs are analyzed with two cases, one with without MPPT controller and other is with the consideration of fuzzy based MPPT controller. These two cases are compared in terms of the output power efficiency, system dynamic response and finally the oscillations behavior.

I. INTRODUCTION

Solar energy is one of the most important renewable energy sources. Renewable energy like wind energy and solar energy are the prime energy sources which are being utilized in this regard. Solar energy is clean, inexhaustible and free. The maximum power that a PV module can supply is determined by the product of the current and the voltage at the maximum power point which depends on the operating temperature and the solar irradiance. The main applications of photovoltaic (PV) systems are in either stand-alone (water pumping, domestic, street lighting, electric vehicles and space applications) or grid-connected configurations (hybrid systems, power plants).

The use of Maximum Power Point (MPPT) Controllers is currently increasing. These devices are responsible for regulating the charge of the batteries, controlling the point at which the PV modules produce the greatest amount of energy possible, regardless of variations in climatic conditions. The solar cell V-I characteristic is nonlinear and changes with irradiation and temperature. In general there is a unique point on the V-I or V-P curve called the Maximum Power Point (MPPT) at which the entire PV system operates with maximum efficiency and produces its maximum output power.

The MPPT techniques will be compared by using MATLAB tool Simulink, created by MathWorks, considering different types of insulation. The PV system implementation takes into account the mathematical model of each component as well as actual component specifications. In this Techniques we have taken two Simulink model (Without MPPT and fuzzy logic with MPPT) shown in model. We will focus our attention on a grid-connected photovoltaic system constructed by a connecting a dc/dc Single Ended Primary Inductor Converter (SEPIC) between the solar panel and the grid. The fuzzy data we have taken from research Paper for Simulink Fuzzy logic MPPT.

II. LITERATURE REVIEW

A. Maximum Power Point tracking from a PV array with high Efficiency

A lower power photovoltaic (PV) system with simple structure has been designed and this method has been verified by PV charging system .It showed that MPPT of PV array can be tracked accurately by applying the charger controller. The maximum power point tracking (MPPT) algorithm for a photovoltaic (PV) panel is based on the PV panel's open circuit voltage and short circuit current. The technique was created using mathematical equations that described the PV panel's nonlinear V-I characteristics. The MPPT algorithm works in a variety of situations, including variable levels of insulation, temperature, and deterioration. The approach is tested in MATLAB, and the results obtained using the algorithm was found to be very similar to theoretical values throughout a wide range of temperature and illumination levels. For the illumination levels and temperatures that a commercial PV panel would encounter, the maximum deviation in maximum power was less than 1.5 percent. This MPPT algorithm's comprehensive derivation was presented. The approach is shown to be faster than existing MPPT algorithms such as perturbation and observation (P&O) and more accurate than approximate methods that rely on the linearity between voltage (current) at maximum power point and open-circuit voltage. This method has several advantages, including a simple current controller and circuit topology independence. This results in great energy conversion efficiency at a low cost for low-power, low-cost applications. For simulation reasons, a novel hybrid PV model was introduced. Finally, simulation results will be presented, demonstrating the algorithm's validity. Solar photovoltaic (PV) systems have been a focus of research for decades, with the goal of increasing the efficiency of solar PV modules. Because the IV curve of a solar PV module is non-linear, some technique is required to track the maximum voltage and maximum current point on the IV curve that corresponds to the Maximum Power Point. As a result, approaches such as Maximum Power Point Tracking (MPPT) were commonly used for this purpose.

B. Maximum Power point Tracking Technique for Photovoltaic System

The most important energy resource is photovoltaic (PV) energy, which is clean, pollution-free, and unlimited. PV energy is gaining popularity in electrical power applications due to significant advancements in semiconductor and power electronics technologies. To maximize the output efficiency of PV arrays, it is critical to operate PV energy conversion systems near their maximum power point. A MPPT is critical for obtaining the maximum amount of power from a solar PV module and delivering it to the load. A survey of contemporary Maximum Power Point Tracking (MPPT) Techniques for Photovoltaic (PV) Systems is offered in this research.

The maximum power point (MPP) of a photovoltaic (PV) array is usually an important component of a PV system. Due to the massive usage and expiration of fossil fuels, renewable energy sources are becoming increasingly important. Solar energy is also the most readily available and cost-free source of energy. The rapid increase in electricity demand, as well as recent changes in environmental conditions such as global warming, necessitated the development of a new source of energy that is less expensive, more sustainable, and emits less carbon emissions. In the search for a solution to the problem, solar energy has yielded promising results. To improve the efficiency of PV modules, a lot of research has been done.

C. Maximum Power Point Tracking

Maximum Point Tracking, or MPPT, is an electrical system that controls the operation of photovoltaic (PV) modules so that they can produce all of the power they are capable of. MPPT is not a mechanical tracking system in which the modules are "physically moved" to aim more directly at the sun. MPPT is a totally electronic system that changes the electrical operating point of the modules to allow them to deliver the greatest amount of power available. Increased battery charge current is made accessible as a result of the additional power gathered from the modules.

D. Fuzzy Logic Controller

Over the last decade, microcontrollers have made fuzzy logic control common for MPPT. Fuzzy logic controllers, as noted in, have the advantages of coping with imprecise inputs, not requiring an exact mathematical model, and handling non linearity. The three stages of fuzzy logic. In this case, five fuzzy levels are used: very low, low, zero, high, very high and use seven fuzzy levels, probably for more accuracy. IC controls are fuzzification, rule basis table lookup, and defuzzification. Fuzzification converts numerical input variables into language variables using a membership function.

E. Selection of Converter

It functions as the MPPT's major component. The goal of a dc/dc converter (step up/step down) is to transfer the maximum amount of power from the solar PV module to the load. A dc/dc converter serves as a link between the load and the power source. When designing an MPP tracker, the most important task is to select and develop a high-efficiency converter that will serve as the MPPT's main component. In, there is a lot of discussion on the efficiency of switch-mode dc–dc converters. The majority of switching-mode power supplies are well-designed to operate at high efficiency levels.

F. Simulation

In this simulation we will compare the two modules without MPPT and With MPPT. We will observe Power, Voltage, and Current waveform of two modules. By climate condition the two modules varies in Voltage and Current. The MPPT algorithm works in a variety of situations, including variable levels of insulation, temperature, and deterioration. The output power of a photovoltaic (PV) module depends on the solar irradiance and the operating temperature, therefore it is necessary to implement the maximum power point tracking controller to obtain the maximum power of a PV system regardless of variations in climatic conditions.

These devices are responsible for regulating the charge of the batteries, controlling the point at which the PV module produces the greatest amount of energy possible, regardless of variations in climatic conditions.

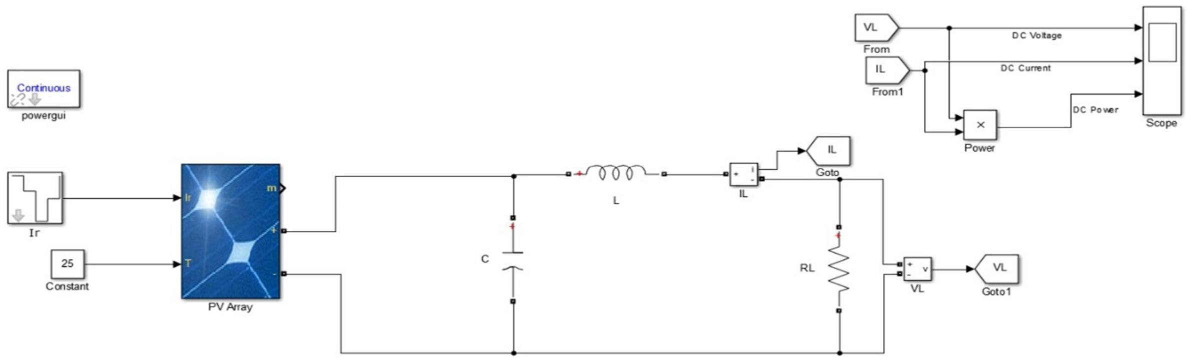


Fig.1: Simulation Model of Without MPPT

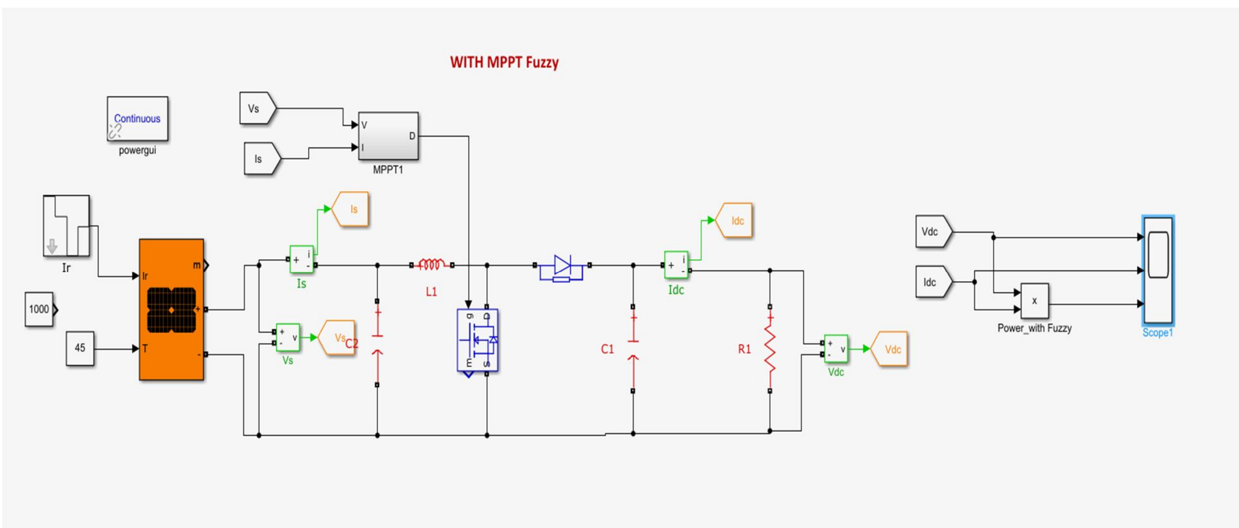


Fig.2: Simulation Model of With MPPT

G. Result

The Fuzzy logic based MPPT controller is proposed in this method to increase the voltage PV module. In both case we will see the Power varies in the form of Voltage and current. In climate condition how much power we will get by MPPT Controller.

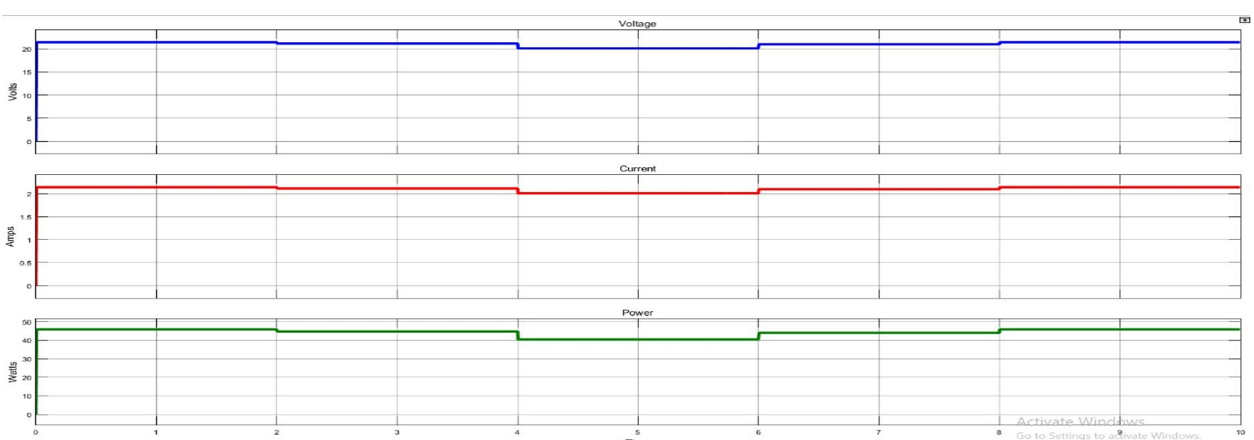


Fig.3: Graph of Without MPPT

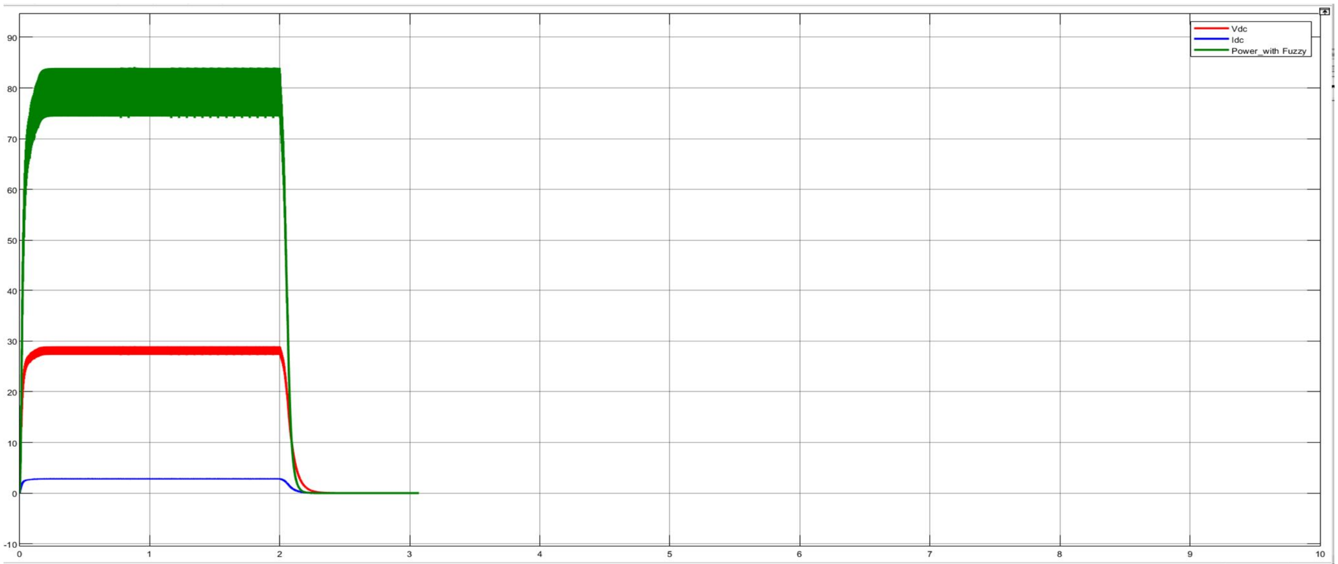


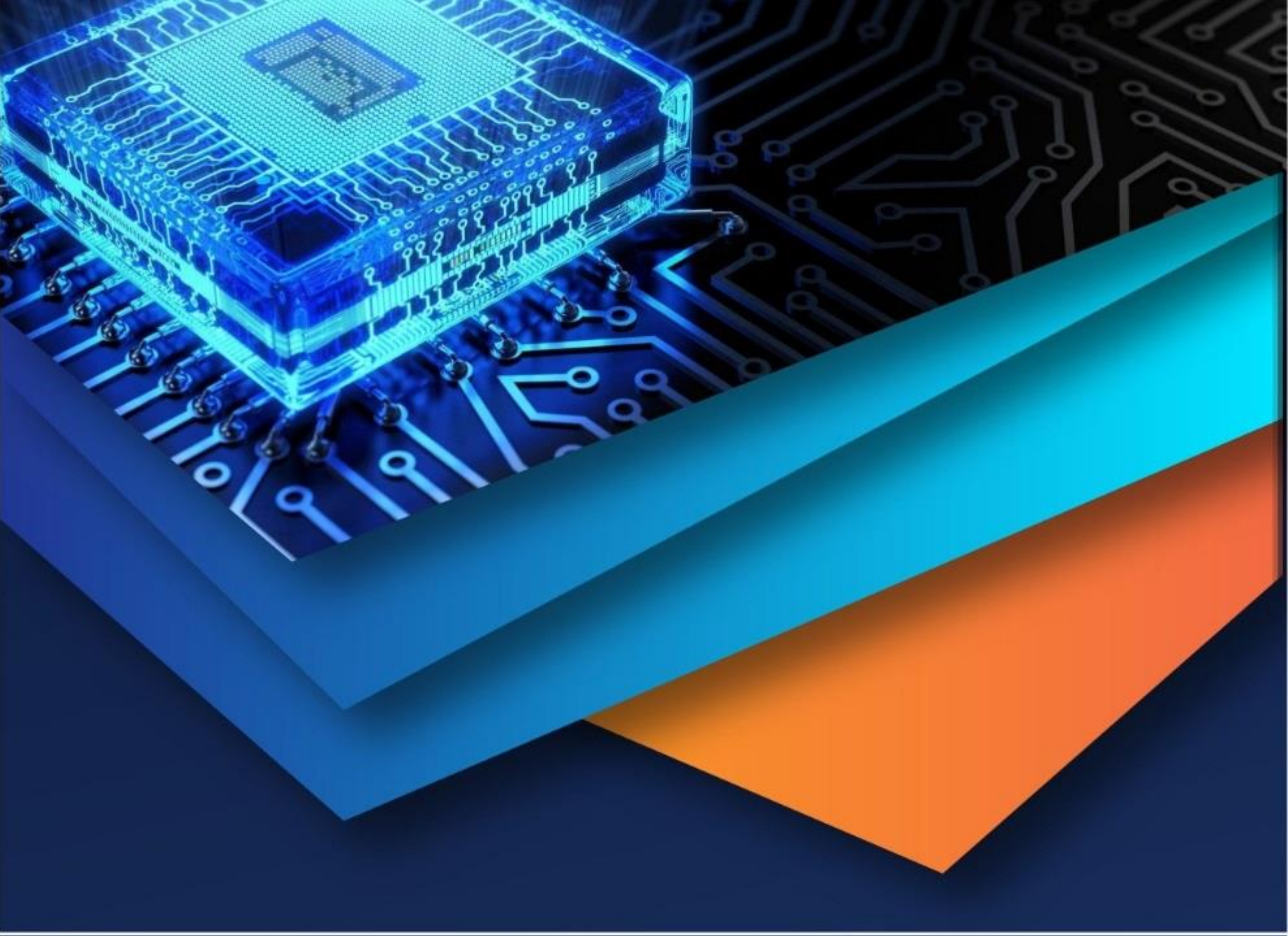
Fig.4: Graph of With MPPT

III. CONCLUSION

Various MPPT approaches are explored in this study. MPPT controller, PV system, and Fuzzy Logic are the most common approaches. We also discuss the benefits and drawbacks of various methods. The implementation of MPPT is straightforward and may be simply created to attain an acceptable efficiency level of the PV modules with a well-designed system containing an appropriate converter and picking an efficient and proven algorithm. We're comparing two modules: one without MPPT and one with MPPT.

REFERENCES

[1] R Boukenoui, H Salhi, R Bradai and A Mellit 2016 A new intelligent MPPT method for stand-alone photovoltaic systems operating under fast transient variations of shading patterns Sol.Energy 124 124–142.
[2] Kumar A, Chaudhary P, Rizwan M. Development of fuzzy logic based MPPT control-ler for PV system at varying meteorological parameters. In: 2015 Annual IEEE India Conference (INDICON); New Delhi; 2017.
[3] "Everything you need to Know About the Basics of Solar Charge Controllers."Northern Arizona Wind & Sun. N.p., n.d. Web. 18 Apr. 2017. <https://www.solar-electric.com/solar-electric.com/solar-charge-controller-basics.html/>.
[4] Padhee S, Pati U C and Mahapatra K 2016 Design of photovoltaic MPPT based charger forlead-acid batteries Emerging Technologies and Innovative Business Practices for the Transformation of Societies (EmergiTech), IEEE International Conference on 351-356 IEEE.
[5] O Guenounou, B Dahhou and F Chabour 2017 Adaptive fuzzy controller based MPPT for photovoltaic systems Energy Convers Manag.
[6] Mahamudul, Hasan, MekhilefSaad, and Metselaar Ibrahim Henk. "Photovoltaic systemmodeling with fuzzy logic based maximum power point tracking algorithm." International Journal of Photoenergy 2018.
[7] Bendib, B., et al. "Advanced Fuzzy MPPT Controller for a stand-alone PV system." EnergyProcedia 50 (2017).
[8] Davison, Alan. "Battery Storage."Battery Storage, types of batteries, charging batteries with Renewable Energy. N.p., n.d. Web. 18 Apr. 2017.
[9] Bounechba, H.; Bouzid, A.; Snani, A.; Lashab, A. Real time simulation of MPPT algorithms for PV energy system. Int. J. Electr. Power 2016.



10.22214/IJRASET

INDEX COPERNICUS
45.98

IMPACT FACTOR:
7.129

TOGETHER WE REACH THE GOAL
IMPACT FACTOR:
7.429

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY