



Article Title: ANFIS Based Routing For the Efficient Transfer of Photovoltaic Parameters

ANFIS Based Routing For the Efficient Transfer of Photovoltaic Parameters

Ramya R.R¹, J. Banumathi²

¹Research scholar, Department of Information Technology, University College of Engineering, Nagercoil, India, remmi.ky@gmail.com

²Assistant professor, Department of information technology, University College of Engineering, Nagercoil, India, jbanu85@yahoo.co.in

ABSTRACT

An accurate performance assessment approach is extremely useful for researching the electrical properties of PV production systems because of the high cost of PV modules. The nonlinear exponential coefficients that are typically used in conventional analytical PV models must have a significant number of unidentified properties discovered before they can be used. Voltage and current are the two separate inputs of the suggested ANFIS, and the outcome is the power output of each arrangement. The recommended model's capability to analytically define current-voltage (I-V) and the conventional techniques for ANFIS-based routing ensure that the data is properly saved in the cloud. The ANFIS networks is trained using evaluation information from various PV array topologies. Results from simulations and experiments support the suggested techniques viability and efficacy.

Key words- PV-Photovoltaic, ANFIS-Adaptive Network-Based Fuzzy Inference System, IoT-Internet of Things.

1 Introduction

Due to its significance in calculating and determining the features of PV systems for various weather conditions, PV modelling has grown to be one of the most crucial phases in the process of collecting solar energy. An effective and exact PV characteristics simulator is essential for a quick and dependable PV system design [1]. Numerous mathematical models have been put out over the last several decades to depict the relationships between PV current and voltage. Due to the silicon PN junction's constant existence, these mathematical models are never linear, and the complexity relies on the chosen circuitual representation. Neural networks are used in an integration system known as ANFIS to improve the inferences that are system. ANFIS generates a collection of fuzzy if-then rules with the needed affiliations to provide the desired input-output pairings [2]. A crucial step that enhances solar PV cell modelling in addition to model selection is the estimate of unknown parameters [3]. Every unknown parameter's precise assessment is crucial to the PV modelling process. Analytical and meta-heuristic optimization approaches are two extensively used procedures for determining unknown parameters [4]. When using an analytical technique, a nonlinear solar PV characteristic is obtained by using various operating conditions in conjunction with



Article Title: ANFIS Based Routing For the Efficient Transfer of Photovoltaic Parameters

numbers from manufacturer datasheets that are readily available. The analytic models are simple to use, but they need a good deal of unidentified parameters to be found first. The accuracy of the models decreases if any of the parameters are not accurately defined [5]. The mathematical formulations of a more sophisticated model often contain more parameters and have a larger computing complexity. To store the data in this routing protocol the best way to choose the ANFIS based routing [6]. Our study's primary goal is to provide accurate findings by including the PV module's unit area under the I-V curve and manufacturing type into the input data. In this work, a model for the PV modules is created using the MATLAB-programmed ANFIS architecture [7]. The suggested ANFIS-based control system responds with precision and speed. The simulation's output shows that, despite changing PV module temperature and irradiance, the maximum power point is properly monitored. The technique, however, does not account for the existence of shade and is not designed for the tracking of the global maximum point [8]. This paper's primary goal is to propose a PV model that is more precise and based on ANFIS, which has the capacity to store data in a cloud [9]. The established method's appropriateness and applicability were confirmed by benchmarking performance indices, taking into account the experimental data points, and comparing them to legacy works for the ANFIS-based routing in PV [10].

2 Proposed Work Explanation

The unique decentralized routing approach used in the suggested ANFIS-based routing activates the local reconfiguration of local node energy evenly across all detectors. In this effort, the IoT was able to enhance network efficiency thanks to the innovative, energy-efficient ANFIS-based routing system. Using ANFIS-based routing, the voltage and current readings from a PV system are stored in an IoT web page.

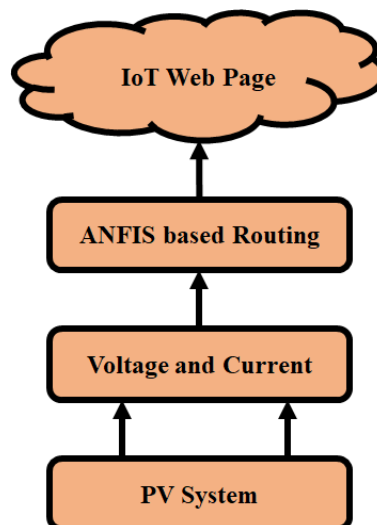


Figure 1: Proposed Diagram



Article Title: ANFIS Based Routing For the Efficient Transfer of Photovoltaic Parameters

This proposed area for routing on an ANFIS-based routing tree spreads out through an interconnected interconnections. Using the method outlined in this part, a routing tree connecting the routers and base stations is produced.

3 Proposed System Modelling

3.1 IoT Web Page

The "Internet of Things" is an interconnected system of tangible things, or "things," that have been given sensors, software, and other characteristics in order to communicate with other systems and gadgets on the Internet. The Internet of Things is one of the many essential technology of our time, and it is fairly new. It is now possible for people, systems, and things to continually communicate because to the ability of embedded devices, such as those found in home appliances, vehicles, thermostats, and baby monitors, to become linked to the web. The smallest amount of human intervention is required for physical items to communicate and gather data thanks to low-cost computers, the cloud, big data, analytics, and mobile technologies. Digital technologies can record, monitor, and modify every interaction between interrelated items in today's hyper connected civilization. The real world and the virtual one are intertwined, notwithstanding their collisions.

3.2 ANFIS Based Routing

Using a number of links to the internet, this advised area for routing on an ANFIS-based routing tree can be seen. A routing tree interconnecting the routers and base stations is created using the procedure described in this section. Base stations will alert their teammates about every entryway after allocating each sensor node to a gateway. To even out the networks power usage and make sure that each node consumes its power equally, distribute the routing loads across the nodes. Instead of creating a defined path between each CH and base station, the process of routing instead offers a range of choices. Either of these alternatives is chosen each time data is transferred to a gateway base station, which might end up in greater network power usage if the terminal's power consumption is unbalanced. A node won't utilize the long path, the short path will vanish, and the long way will be used to convey data if the remaining current on the other paths is not too low, according to the recommended routing behavior, which takes into consideration the length of the data communication pathway. Calculate the most excessive location of the generating sensor node and the receiving sensor node to get the exchange distance of each sensor node. The Euclidean space becomes a measuring space at this location. The Euclidean rule is the name of the corresponding rule. The separation in Euclidean space between two focuses is known as the distance Euclidean. The L2 rule or L2 distance is the common name for the Euclidean standard.



Article Title: ANFIS Based Routing For the Efficient Transfer of Photovoltaic Parameters

$$d(i, j) = \sqrt{\sum_{i=1}^K (in - jm)^2} \quad (1)$$

The location of a point in Euclidean n-space is known as its Euclidean velocity. Because of this, I and j can be viewed as Euclidean matrices that begin at the original starting point of the space and end at both ends, accordingly.

3.3 PV System

A number of sequences and comparable mixtures of PV modules, a following supervisor, and power converters such a DC-DC converter and inverter make up the PV system used for power adaptation. As a result, the DC voltage produced may be improved using a DC to DC converter and converted to AC using an inverter. The PV panel should be certain originated on the weight rating.

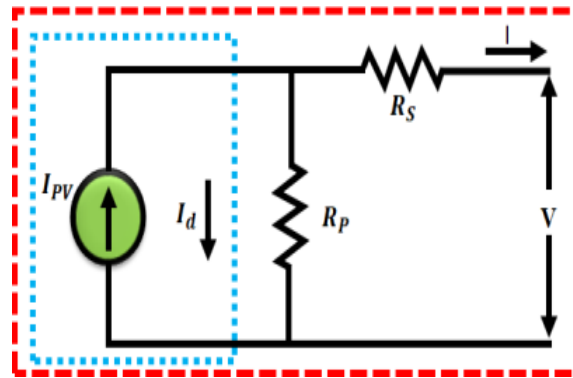


Figure 2: Corresponding circuit of PV cell

The diode Shunt resistance R_{sh} , Series Resistance R_s , Shunt Resistance R_{sh} .

$$I = I_{ph} - I_d - I_{sh} \quad (2)$$

$$I_d = I_0 \left\{ \exp \left[\frac{q}{mkT_c} (V + IR_s) \right] - 1 \right\} \quad (3)$$

$$I_{sh} = \frac{V + IR_s}{R_{sh}} \quad (4)$$

By applying Calculations is shown below

$$I = I_G - I_0 \left\{ \exp \left[\frac{q}{mkT_c} (V + IR_s) \right] - 1 \right\} - \frac{V + IR_s}{R_{sh}} \quad (5)$$

Typically shunt Resistance R_{sh} in PV cells is high hence $\frac{V + IR_s}{R_{sh}}$ is removed

$$I = I_G - I_0 \left\{ \exp \left[\frac{V + IR_s}{A} \right] - 1 \right\} \quad (6)$$



Article Title: ANFIS Based Routing For the Efficient Transfer of Photovoltaic Parameters

Where A=curve fitting restriction

$$A = \frac{mkT_c}{q} \quad (7)$$

According to Fig.2 output current at normal trial circumstance is

$$I = I_{ph} - I_0 \left[\exp\left(\frac{V}{A}\right) - 1 \right] \quad (8)$$

After PV cell is dumpy circuited

$$I_{sc} = I_{ph} - I_0 \left[\exp\left(\frac{0}{A}\right) - 1 \right] = I_{ph} \quad (9)$$

$$I_{ph} \approx I_{sc} \quad (10)$$

The photocurrent rest on composed irradiance and temperature

$$I_{ph} = \frac{G}{G_{ref}} (I_{ph} + \mu_{sc} \cdot \Delta T) \quad (11)$$

The voltage (V_{mp}) and current (I_{mp}) at maximum power is

$$I_{sc} = I_{ph} - I_0 \left[\exp\left(\frac{I_{sc} R_s}{A}\right) - 1 \right] \quad (12)$$

$$0 = I_{ph} - I_0 \left[\exp\left(\frac{V_{oc}}{A}\right) - 1 \right] \quad (13)$$

$$I_{pm} = I_{ph} - I_0 \left[\exp\left(\frac{V_{pm} + I_{pm} R_s}{A}\right) - 1 \right] \quad (14)$$

According to Equation (11) substituting (I_{ph}) in Equation (14)

$$0 \approx I_{sc} - I_0 \exp\left(\frac{V_0}{A}\right) \quad (15)$$

Hence,

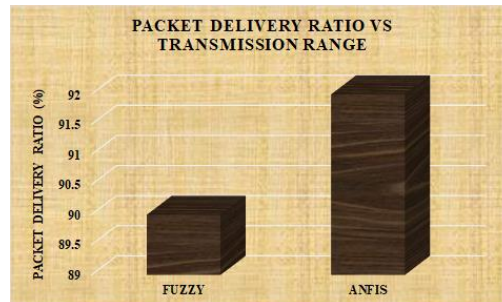
$$I_0 = I_{sc} \exp\left(\frac{-V_{oc}}{A}\right) \quad (16)$$

4 Result and Discussion

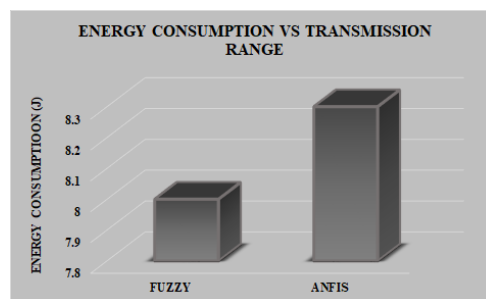
In this research, a system for ANFIS based routing is described. Applications for the IoT are made viable by factors like dependability, security, privacy, and resilience. Using ANFIS routing, the voltage and current is successfully identified and stored in IoT web page.



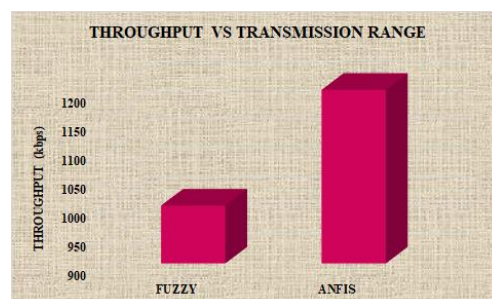
Article Title: ANFIS Based Routing For the Efficient Transfer of Photovoltaic Parameters



(a)



(b)



(c)

Figure 3: Comparison of delivery ratio, energy consumption and throughput with respect to transmission range

From the above figures it is concluded that the proposed ANFIS control exhibits the better results compared to Fuzzy Controls. The proposed ANFIS gives out high throughput, better delivery ratio and reduced energy consumption.

5 Conclusion

An estimating model for predicting the data of various types of PV modules has been developed in this research and is based on the ANFIS. With the help of environmental data, the suggested technique is capable of getting I-V on ANFIS-based routing. The simulation



Article Title: ANFIS Based Routing For the Efficient Transfer of Photovoltaic Parameters

outcomes show that the recommended PV estimate model is becoming more accurate in terms of prediction, and that the I-V curves predicted by the recommended model are very comparable to those derived from the observed data. The proposed model's resilience is supported by a comparative analysis of PV model performance tests conducted under various circumstances.

References

1. Humada Ali M.; Salih Y. Darweesh; Khalid G. Mohammed; Mohammed Kamil; Samen F. Mohammed; Naseer K. Kasim; Tahseen Ahmad Tahseen; Omar I. Awad; Saad Mekhilef, Year: 2020, "Modeling of PV system and parameter extraction based on experimental data: Review and investigation," Solar Energy, Vol: 199, pp. 742-760.
2. Venkateswari Radhakrishnan; Natarajan Rajasekar, Year: 2021, "Review on parameter estimation techniques of solar photovoltaic systems," International Transactions on Electrical Energy Systems, Vol: 31, no: 11, pp. e13113.
3. Panapakidis Ioannis P; Georgios C. Christoforidis, Year: 2017, "A hybrid ANN/GA/ANFIS model for very short-term PV power forecasting," In 2017 11th IEEE International Conference on Compatibility, Power Electronics and Power Engineering (CPE-POWERENG), pp. 412-417. IEEE.
4. Belhachat Faiza; Cherif Larbes, Year: 2019, "Global maximum power point tracking based on ANFIS approach for PV array configurations under partial shading conditions," Renewable and Sustainable Energy Reviews, Vol: 77, pp. 875-889.
5. Bi Ziqiang; Jieming Ma; Xinyu Pan; Jian Wang; Yu Shi, Year: 2017, "ANFIS-Based modeling for photovoltaic characteristics estimation," Symmetry, Vol: 8, no: 9, pp. 96.
6. Al-Majidi Sadeq D; Maysam F. Abbod; Hamed S. Al-Raweshidy, Year: 2019, "Design of an efficient maximum power point tracker based on ANFIS using an experimental photovoltaic system data," Electronics, Vol: 8, no: 8, pp. 858.
7. Rao N. Srinivas, Year: 2021, "Wireless sensor network routing for life time maximization using ANFIS based decision with low power consumption," Turkish Journal of Computer and Mathematics Education (TURCOMAT), Vol: 12, no: 2, pp. 2893-2900.
8. Ali A. Nazar; R. Jayabharath; M. D. Udayakumar, Year: 2018, "An ANFIS based advanced MPPT control of a wind-solar hybrid power generation system," choice, Vol: 11, pp. 14.
9. Nikolovski Srete; Hamid Reza Baghaee; Dragan Mlakić, Year: 2018, "ANFIS-based peak power shaving/curtailment in microgrids including PV units and BESSs," Energies, Vol: 11, no: 11, pp. 2953.



Article Title: ANFIS Based Routing For the Efficient Transfer of Photovoltaic Parameters

10. Ragul R; N. Shanmugasundaram; Mariaraja Paramasivam; Suresh Seetharaman; Sheela L. Mary Immaculate, Year: 2023, "PV Based Standalone DC-Micro Grid System for EV Charging Station with New GWO-ANFIS MPPTs under Partial Shading Conditions," International Transactions on Electrical Energy Systems.