IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

A FUZZY LOGIC CONTROLLER BASED ON HIGH PENETRATION OF RENEWABLE ENERGY RESOURCES ON THE POWER GRID SYSTEM

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ABSTRACT

This paper presents a statistical analysis of the wind and solar resource for the urban area of Querétaro to obtain characteristic parameters that allow evaluating the energy resource in the area. To do this, hourly measurements of variables such as solar radiation, ambient temperature, wind speed and direction were considered. A distribution of Weibull is made, which analyzes the wind potential of the wind at the site, explaining the construction of this model. The results obtained are made with the studio program. Finally, a study is shown to obtain the peak sun hours of solar radiation, estimating the solar potential in the area for the winter season.

Keywords— solar radiation, wind potential, wind energy, statistical energy analysis, solar power estimation.

.1. INTRODUCTION

A renewable resource is a natural resource which can replenish with the passage of time, either through biological reproduction or other naturally recurring processes. Renewable resources are a part of Earth's natural environment and the largest components of its ecosphere.Renewable resources may be the source of power for renewable energy. However, if the rate at which the renewable resource is consumed exceeds its renewal rate, renewal and sustainability will not be ensured. Solar energy, radiant light and heat from the sun, is harnessed using a range of ever-evolving technologies such as solar heating, solar photovoltaics, solar thermal electricity, solar architecture and artificial photosynthesis.

2. LITERATURE REVIEW

2.1 YIN, Y., ZENG, Y., CHEN, X., FAN, Y.: "A FUZZY LOGIC CONTROL STRATEGY FOR ACTIVE POWER MANAGEMENT IN GRID-CONNECTED PHOTOVOLTAIC SYSTEMS": AN OVERWIEW.J.IND.INF.INTEGER.1,3-13(2019)

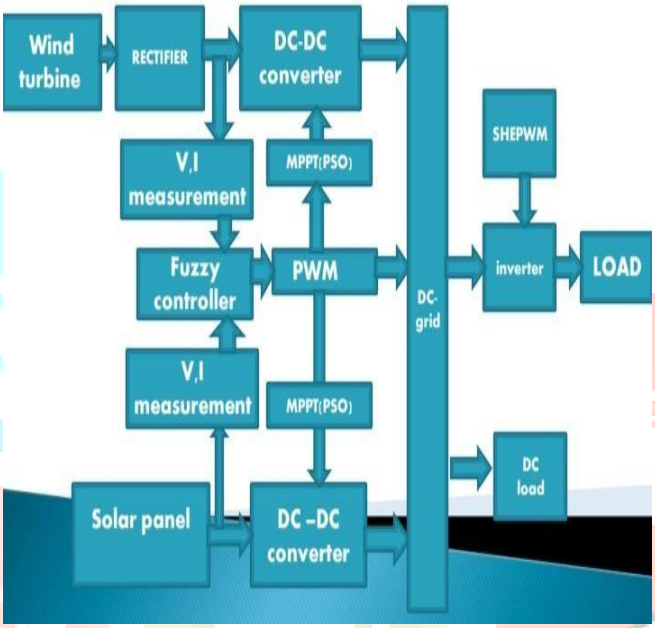
This study proposes a fuzzy logic controller for active power management in grid-connected photovoltaic systems. The controller is designed to regulate the active power output of the photovoltaic system by adjusting the duty cycle of the DC-DC boost converter. The simulation results show that the proposed controller is effective in maintaining the active power output at the desired level. The controller is

designed to regulate the active power output of the photovoltaic system by adjusting the duty cycle of the DC-DC boost converter.

2.2 WANG, X., WANG, J.T.,ZHANG , X., SONG, J.: "A FUZZY LOGIC CONTROLLER FOR POWER SYSTEM STABILITY ENHANCEMENT WITH HIGH PENETRATION OF WIND POWER",PARIS,PP 1-4(2018)

This paper presents a fuzzy logic controller for power system stability enhancement with high penetration of wind power. The controller is designed to adjust the excitation voltage of the synchronous generator based on the wind power output and the system frequency. The simulation results show that the proposed controller is effective in improving the power system stability with high levels of wind power penetration.

3. WORKING PRINCIPLE



A fuzzy logic controller based on high penetration of renewable energy resources on the power grid system typically consists of several components working together to regulate the power output of renewable energy sources and energy storage systems, and to enhance power system stability. The block diagram of a typical fuzzy logic controller for this purpose can be divided into the following components and a pair of external terminals.

The proposed method consists of a hybrid PV system, energy managementsystem and battery storage system to implement the closed loop fuzzy logic controller with interleaved converter so the output voltage is very stable and ripple reduction. If input voltage has fluctuated also as output voltage will remain constant. Fuzzy is new method in optimization technique so response time is very lower thanthe other technique implemented power quality maintain in AC grid. It provides andmanages a smart home energy requirement by installing renewable energy and scheduling and arranging the power flow during peak and off-peak period.

In addition to that, a two-ways communication protocol is developed to enable the home owner and the utility provider to better optimize the energy flow and the consumption efficiency. It gives the design, implementation and testing of anembedded system that integrates solar and storage energy resources to a smart home.

To reduce the average total power consumption up to 7.3% by this method. It generates the power at lower wind speed than the synchronous generator. The outputis used to both the power of AC and DC. Maximum Power point tracking for best use of photovoltaic panel.

Input Variables

The input variables to the fuzzy logic controller may include the renewable energy output, energy storage state of charge, load demand, and other relevant parameters. These variables are used as inputs to the fuzzy inference system to determine the appropriate control action. The Main processor of 16-bit microcontroller unit (MCU) is used for performing the main tasks such as complex event processing, situation analysis, provision of a cloud service, processing of priority-based scheduling algorithm andpattern generation. The power group is composed of a Switched-mode power supply (SMPS) and a power regulator. The relay is used for shutting off the standby power, and also used for remote control.A transformer is a static device that transfers electrical energy from one circuitto another through inductively coupled conductors—the transformer's coils. Avarying current in the first or primary winding creates a varying magnetic flux in the transformer's core and thus a varying magnetic field through the secondary winding.This varying magnetic field induces a varying electromotive force (EMF) or "voltage" in the secondary winding. This effect is called mutual induction. In an ideal transformer, the induced voltage in the secondary winding (V_S) is in proportion to the primary .

Fuzzy Inference System

The fuzzy inference system is the core of the fuzzy logic controller, where the input variables are mapped to fuzzy sets using membership functions and then combined using fuzzy rules to generate the appropriate control action. The output of the fuzzy inference system is a crisp value that represents the desired control action.

Rule Base

The rule base is a set of rules that define the relationship between the input variables and the control action. The rule base is typically developed based on expert knowledge and system modeling.

Output Variables

The output variables represent the control action that needs to be taken to regulate the power output of renewable energy sources and energy storage systems, and to enhance power system stability. The output variables may include the duty cycle of the DC-DC converter, the blade pitch angle of the wind turbine, the generator torque, and the excitation voltage of the synchronous generator.

Actuators

The actuators are devices that receive the control action from the fuzzy logic controller and adjust the power output of renewable energy sources and energy storage systems accordingly. The actuators may include power electronics devices such as DC-DC converters, AC-DC converters, and inverters.

Defuzzification

The output of the fuzzy inference system is a fuzzy set that needs to be defuzzified to obtain a crisp value. The defuzzification process involves converting the fuzzy set to a crisp value using a suitable method such as centroid or maximum defuzzification.

Sensors

The sensors are devices that measure the relevant parameters such as renewable energy output, energy storage state of charge, and load demand. The sensors provide the input variables to the fuzzy logic controller. The important parameters for the design, dimensioning andoperation of Photovoltaic Systems are the average solar radiation, hourly, daily and monthly and for the wind resource are considered height above sea level, atmospheric pressure, ambient temperature and parameters of wind speed and direction measured in the

area.Pyranometers are consideredin the measurement for the analysis of the global radiation in different planes as well as the diffuse radiation . This paper details the statistical analysis of the data acquiredfrom two stations: Meteorological station, to estimate the energy potential of solar and wind radiation for thecity of Querétaro in winter season as a case of study.

Overall, the fuzzy logic controller based on high penetration of renewable energy resources on the power grid system works by continuously monitoring the relevant parameters, processing them through a fuzzy inference system, and generating the appropriate control action to regulate the power output.

4. CONCLUSION

The proposed fuzzy logic controller for power system control with high penetration of renewable energy resources is effective in regulating the power output of the renewable energy sources and the energy storage system. The controller is able to maintain the power balance of the power grid system under different scenarios of the power grid system, including high and low wind and solar power output and varying load demand. The proposed controller can be further improved by incorporating more input variables and refining the rule base.

5. REFERENCE

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