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Neural Network Based Energy Management for Hybrid Renewable System Design for Residential Load

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ABSTRACT: The projected energy management system is designed to improve the efficiency of a hybrid micro grid system that uses solar modules, wind turbines, and battery storage devices. It is programmed to execute various tasks such as balancing the system's voltage and current, and generating and storing energy. For minimizing power-flow resistance and maintaining a constant voltage, the proposed system uses an Artificial Neural Network. A fuel cell is added to a solar-powered system to ensure that the electricity flows continuously.

Keywords: power management, ANN , Power flow resistance.

1. INTRODUCTION

The change of renewable energy sources and the technologies that support them has accelerated during the last few decades, as energy is now acknowledged as a major destination. Governments all throughout the world have enacted this legislation. new rules and laws that encourage the use of technology for renewable energy. Various renewable energy sources, secondary energy sources, and storage technologies have all been developed. Because renewable sources are unreliable, combining them with conventional sources to support discrete loads or mini-grids far from the main grid is the best way to ensure supply continuity. A hybrid energy system is one that makes use of multiple energy sources.[1] Conventional techniques for regulating hybrid power systems, such as the PI controller, are slow, instable, and unsuitable for systems that are subject to weather changes. This resulted in the advancement of more people. Intelligent procedures capable of dealing with all types of new dynamics.

This study examines the energy management strategies used in renewable power systems, with a focus on isolated hybrid renewable energy sources and systems that are connected to the grid.[2] A dynamic modelling and control technique for a sustainable microgrid powered mostly by wind and photovoltaic (PV) energy and fuel cell are presented in this article. [9]To set the stage for the discussion, the microgrid's envisioned applications include a residential area as part of a future "smarter grid" Energy storage equipment, such as batteries, are also included in the intended microgrid.[3] The fundamental challenges are PV generation efficiency and electricity quality[11]. The goal of guaranteeing maximum power point (MPP) operation is usually accomplished by integrating PV power sources with control algorithms. Many methods have been developed to track a solar array's maximum power point.[4] Due to their high energy density and clean energy, fuel cells are seen as the most attractive choice among upcoming energy technologies.[5] Photovoltaics and wind power, which have been seen as promising to fulfil rising electricity demand and play a key part in clean energy generation. Renewable energy, on the other hand, is heavily reliant on wind speed or solar radiation.[6] This paper presents an integrated controller and a grid-connected multiple-input converter that are used to perform various tasks related

to battery charging and monitoring of solar PV panels and WTG. It is designed to be used with immediate load demand [7].

2. METHODOLOGY AND DESCRIPTION

2.1 SOLAR PANEL:-

Most basic component of a PV system is solar cell. It uses the energy from sunlight to generate electrical energy. The electrons in the photon pair then travel towards the p-region and the nregion, respectively. A solar cell transforms solar into electrical energy[10]. When solar light hits a cell, its energy produces an electron-hole pair. The electron-hole pair is separated due to the electric field forming at the junction. As a result, the voltage is produced at the output. The goal of guaranteeing maximum power point (MPP) operation is usually accomplished by integrating PV power sources with control algorithms[8]. Many algorithms have been developed. created to track a solar panel's greatest power point array. If the MPPT operation is completed without too much variation, it will also reduce the ripple at the PV module terminals, increasing system efficiency. In the coming years, researchers are expected to focus on reducing current or voltage ripples.[4] The PV system has two fundamental flaws: its electric power generation conversion efficiency is low, and the amount of electricity generated by the solar array varies. as a result of fluctuations in insolation as a result of clouds, birds, trees, and other objects cast strange shadows forth.[7]

Cogitate

$$I = I\mathrm{PV} - ID - I\mathrm{SH},$$

$$I = I\mathrm{PV} - \{\exp[q\,(V\mathrm{PV} + IRS)/mkT] - 1\} - V\mathrm{PV} + IRS/R\mathrm{SH} \quad \ldots (1)$$

2.2 WIND ENERGY:-

The mechanical energy produced by a wind turbine is then converted to electrical energy, which is required to be used by a generator. The MPPT controller is designed to handle the varying requirements of the wind turbine. The load impedance is constant. A power supply electronic converter is used to match the load and its source impedance.

The torque= is power/ generator speed as in:-

$$Tm=(\lambda,\beta)\,\rho AV3\omega m, \quad (2)$$

Where,
ωm=generator speed.
Cp=coefficient of performance.
ρ=density of air.
A=area swept by turbine blade.
V=wind velocity.

2.3 FUEL CELL:-

A fuel cell is a galvanic system in which the chemical reactions are carried out. The energy of a fuel is instantly turned into electricity. The electrochemical process is used to generate energy. The source of energy continuously and independently, oxidizing agents are used. Given to the cell's two electrodes, where they go through a reaction to keep your body hydrated, you'll need an electrolyte. The fuel cell is an energy storage device that can provide a high-power density and zero-emissions operation. Its unique characteristics make it an attractive choice for various applications. The flow rate controller of a fuel cell is changed depending on the order in which the power supply is required to generate the necessary power [7].

2.4 BATTERY CELL:-

The battery is the device that stores energy in an electrochemical form. The most extensively utilized energy storage device in a number of applications Electric and hybrid electric vehicles, for example, are examples of such uses.[5] `hybrid power plants. To sink/source, a battery is employed as an external levelling agent. Since the upfront and maintenance expenditures are lower. The battery's charging and discharging times are estimated.
based on the battery handbook's standard specs.[7]

For a 150Ah battery the charging current (3) should not exceed 15A

IBattCh = 0.1 × 150 = 15A. (3)

The boost converter being 95% (ηBoost-Conv = 0.95) will be Calculated as in (9):

$$CB = \frac{Po}{0.1 \times \eta\text{Boost-Conv} \times V\text{Bat-min}},$$

$$CB = \frac{1500}{0.1 \times 0.95 \times 99},$$

CB= 159.489 Ah. (4)

Hence a 150Ah battery is selected.

The maximum battery discharge current (11) at the output of the boost converter to deliver a power of 1.5 kW at the battery voltage of VBat-min = 99V and ηBoost-Conv = 0.95 is

$$I\text{BattDch} = \frac{Po}{\eta\text{ Boost-Conv} \times V\text{Bat-min}},$$

$$I\text{BattDch} = \frac{1500}{0.95 \times 99}$$

= 15.94A. (5)

3 SIMULATION RESULTS:

ANN Based MPPT tracking is more reliable than conventional control methods.

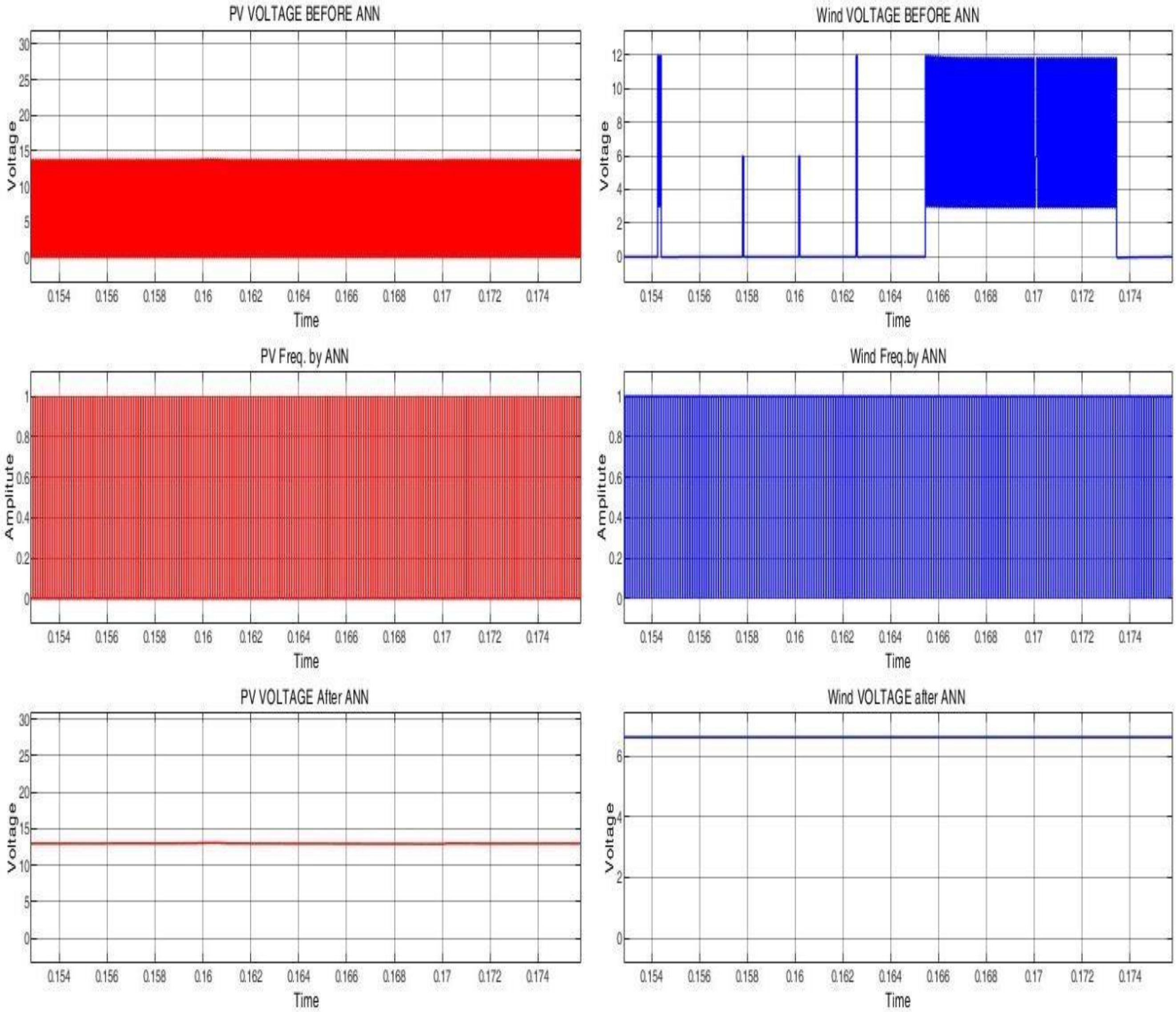

Fig.6. Before and after ANN Voltage of PV & Wind.

4 CONCUSION

The implanted controller-based power system can provide a balance of input and output power to meet the load demand. This eliminates the need for separate power sources for different outputs. The simulation results of the power management system which were obtained from the star center, KEC, are encouraging.

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