Embeded control system for integration of renewable energy sources into grid

ABSTRACT
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ABSTRACT

Keywords: Photovoltaic (PV), Maximum power point tracking (MPPT), The hybrid renewable energy, Wind system, A Pitch angle.

The people are constantly looking for novel sources of electricity to satisfy their growing demands in the uses of the advanced life we live in. Many energy sources are depleted and have a negative impact on the environment. In modern times, humans have been alerted to the possibility of taking advantage of the heat of the sun's rays, Renewable and irreversible, and I am aware of the high risk caused utilizing another and common sources of energy mostly gas and oil for pollution and destruction of the environment.

Solar energy offers the satisfying option ever. Therefore, solar energy in our time has become a national income of several nations, so that in the Arab countries, which are the of the world's richest oil, solar energy is used basically and effectively. The solar power has been implemented to produce electricity in several applications, including energy generation and desalination plants, the running of traffic lights and street lighting, and the operation of certain electrical devices such as clocks. Calculators, satellites, vehicles and space stations.

With the rise in electricity prices in many countries around the world and the continued disruption of the electricity regulator in some countries, especially the developing countries, people are turning to renewable energies like wind power and solar energy. They are environmentally friendly and free of charge. The solar power has become an essential area in the choices of renewable energy, but the extent of benefit is correlated with the appearance of daylight during the time of use, similar traditional energy.

It appears that the needed techniques after the technology and improvement of electricity also the thermic conversion of solar power are the technology of storage of that energy to and benefit from the period of blocking of solar radiation.

Also, the wind energy is used as a standing a source of power production, as a substitute for fossil fuels, gas, and oil. All these sources do bad sources of the environment because they produce toxic gases when burned, and are not available in all areas of the world.

The wind power is a very fast source of energy in the entire world. For years, the interest of all countries has been to study and learn about wind energy as an alternative, renewable and continuous source. Electricity is generated by using very simple and inexpensive technology, to obtain free and efficient electrical energy.

Because of this, many countries have worked over the last 20 years to develop wind turbine products to obtain five megawatts of electricity at nominal wind speed. Today, wind farms can maintain energy equivalent to their power and quantity. Thus, creating a renewable energy source that meets the growing demands as technology continues to evolve.

We can consider wind power as a form of solar power, where the wind is formed by several factors:

1. Distribution of unequal solar radiation in the atmosphere.
2. Different terrain heights on the Earth's cover.
3. Rotate the earth around itself and around the sun.

The wind energy is the least costly and most assuring source of renewable energy compared to every other source, however its various nature, so the wind does not always blow, makes the researchers plan what will have an influence on desalination systems and their output processes.

Wind-powered technology for generating electricity is the fastest growing new power source globally. Wind energy is produced by wind-powered three-arm engines (or turbines) placed at the top of long towers and acting as fans. However, in reverse rather of utilizing electricity to output the wind as fans do, these turbines utilize wind to generate power. The amount of power provided by wind turbines rely on the velocity of the wind and the diameter of the

blades; therefore, the turbines used to run the plants or to light up the towers are installed because the wind velocity grows with the height of the earth.

The excellent position to install the turbines (wind field output) should have an average annual wind speed of less than 12 mph. Unlike wind power production, the wind can provide mechanical energy utilized in a broad range of applications, like water pumping, irrigation, grain drying and water heating.

Hybrid renewable energy system consisting of solar PV system and wind turbines is proposed to achieve an efficient, robust, reliable and cost competitive system which is suitable for PV to ensure the maximum power in case of fluctuation in the weather and abrupt low, high wind speed and varying wither discharge. The proposed system configuration is explored for the possibility to electrify remote areas where solar PV and wind system.

The present research work is comprised of three sections on and around the theme of the thesis.

In the first section, the inverter is an essential part of any PV based system, which can regulate the current flow between the grid and PV array. However, the problem of integration of PV is that it relies on weather conditions which will affect the output of PV. The aim of research work is to develop a controller for integration of PV system into a grid using MATLAB/Simulink.

The PV integration is linked to the boost DC/DC converter and the controller system is based on the maximum power point tracking (MPPT) with PI controller that helps PV to ensure the maximum power in case of fluctuation in the weather, and then integrated into the AC utility grid by DC/AC inverter.

In the second section, the problem of integration of wind is that it relies heavily on weather conditions and air speed. So, there is a necessity for developing control techniques for grid integration wind system including a method for voltage and current control that stabilizes the output power. A control scheme for integration wind energy conversion system into the

utility grid is presented. Here, a PID controller for the system is tested under different weather conditions. A pitch angle controller module with PID control is developed that is suitable for wind power conversion system. Then, the system behavior and performance are studied. The system stability is also considered when there is a change in pitch angle or a fault in the system. This research work emphasizes that the suggested PID controller proffer a great performance.

In the third section, the problem of integration of hybrid renewable energy is that it relies heavily on the output of PV and wind system. So, there is a necessity to develop a control technique for a grid integration of hybrid renewable energy based systems which generally includes a method for voltage and current control that stabilizes output.

Here, a fuzzy logic controller is presented that is suitable for regulating hybrid renewable energy based system. The system stability tests for different weather conditions in PV and air speed or a fault in the system. This research work advocates that the proposed fuzzy logic based PID controller gives a good performance over regular control methods. The MATLAB/SIMULINK model for integration of the hybrid system is developed and the results are presented.

The whole work was done which is being presented in the thesis is summarized below:

1. Overview of the energy scenario and power demand trends in India and across the globe is presented. Hybrid power system needs, advantages, and comparison with single source system is outlined.
2. A literature survey of solar PV power system, wind power conversion systems, hybrid power systems, inverter control and energy management methods is presented.
3. The PV integration is linked to the boost DC/DC converter and the controller system is based on the maximum power point tracking (MPPT) with PI controller that helps PV to ensure the maximum power in case of fluctuation in the weather, and then integrated into the AC utility grid by DC/AC inverter.

4. Developed a controller for integration of PV system into a grid using MATLAB/Simulink.
5. PMSG based vertical axis wind turbines with control at low and medium wind speeds and constant power stalling at excessive wind speeds is proposed.

   The new constant electrical power stalling based on the concept of, and aims at, keeping controlled generated power at wind velocities above rated value is developed. The design of the controller is simple, easy to implement and does not require any mechanical sensor or controller.
6. A PMSG coupled variable speed which is able to track MPP as per the water discharge available is developed. A control scheme for integration wind energy conversion system into the utility grid is presented. Here, a PID controller for the system is tested under different weather conditions.

   A pitch angle controller module with PID control is developed that is suitable for wind power conversion system. Then, the system behavior and performance are studied.
7. Developed a control technique for a grid integration of hybrid renewable energy based systems which generally includes a method for voltage and current control that stabilizes output. Here, a fuzzy logic controller is presented that is suitable for regulating hybrid renewable energy based system.
8. The system stability tests for different weather conditions in PV and wind air speed or a fault in the system. This research work advocates that the suggested fuzzy logic based PID controller gives a good performance over regular control methods. The MATLAB/SIMULINK design for integration of the hybrid system is developed and the results are presented.

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