A Wind and Solar Power Generation Data Collection System for Public Buildings

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Abstract. In view of the high power current source inverter (CSI) switching frequency is limited and system load parameter is variable, system output performance is affected. An interconnection and damping assignment of passivity-based control (IDA-PBC) for three-phase CSI is proposed. The lumped-parameter model of three-phase CSI with independent storage unit is established, and its port-controlled Hamilton (PCH) model in Park coordinate is proposed. The control rate of the closed-loop system is obtained by solving the parametric partial differential equation based on interconnection and damping assignment. The controller is designed, and the system stability is analysed by Lyapunov function. The simulation and experiment results show that the inverter can output a good sinusoidal voltage, which has strong anti-interference ability to the load disturbance. The stability and robustness of the system are also improved.

Keywords: Scenery Power Generation, Host Computer, Slave Computer, Data Acquisition System, Solar Power

1. Introduction

Wind resource and energy resources are highly complementary in different seasons and different geographical and climatic conditions, combine the two, a good balance of energy conversion performance and working reliability can be achieved [1]. The new generation mode complementary scenery so as. Wind power and solar power device can display method of way, if we have a data communication and storage function, can wind and solar energy to maximize use of resources, and effectively reduce the cost, resources can effectively collect and store wind and solar energy, wind power generation equipment, in order to optimize the matching capacity of light [2].

A set of complementary power generation system is the use of photovoltaic cell array, wind turbine generator (converts AC to DC) will be issued to the electric energy storage battery, when need electricity, inverter DC will change the storage battery into AC, sent to the load through the transmission line [3]. The upper computer of the wind and wind complementation system can directly send out control commands and display various signals on the screen such as hydraulic, water level, temperature, etc.. The lower computer direct control device and acquisition device
2. Design of Demonstration Device for Wind and Solar Power Generation

To broaden the students’ horizons, the popularity of renewable energy knowledge, enhance the awareness of environmental protection, will help students to learn the theory of knowledge and combined with practical application, improve their comprehensive quality, at the same time, taking into account the experimental demonstration of intuitive, vivid and flexibility requirements, based on complementary wind power generation demonstration device principle. It is necessary to introduce new energy in Higher Vocational teaching. For this reason, a small wind solar hybrid power generation demonstration device has been designed and made. The device has realized the characteristics of miniaturization, visualization, highly modular and simple operation. The basic structure of wind solar hybrid power generation device is mainly composed of wind turbine, PV module, blower, photovoltaic controller, battery and inverter.

2.1. Wind Power Part

Wind power generation is mainly divided into two parts: wind turbine and generator. The core power unit is the wind blade part, and the efficiency of wind turbine blade part can be drawn according to Formula 1.

\[ P = 0.49v^3D^2C_p \]  \hspace{1cm} (1)

Where \( P \) is the power of blade generation, \( v \) is rated wind speed, that is, infinitely far flow speed, \( D \) is the diameter of the wind wheel, and \( C_p \) is the power factor.

2.2. Photovoltaic Generation Part

Solar photovoltaic cells, referred to as photovoltaic cells, are important components that directly convert solar energy into electrical energy. They are widely applied in daily life and industrial engineering. Its working principle is the photovoltaic effect of PN junction, that is, PN junction generates electrons and holes under illumination, and concentrates on the \( N \) region and \( P \) region respectively, resulting in the generation of photovoltaic potential from the \( N \) layer to the \( P \) region.

The device is used to work on the characteristics and working mode of the photovoltaic cells. When the light intensity is stable, the photo generated current produced by the photovoltaic cell is basically the same, so it can be considered as a constant current source in the equivalent circuit. The access of the load \( R \) will make the circuit close and generate the current, and the voltage \( v \) is generated at both ends of the load. Photovoltaic cell itself is a PN junction. Its basic characteristics are similar to that of diode. So the load terminal voltage reacts on the photovoltaic cell itself, producing the opposite direction to the photo generated current, as shown in Figure 1.
In practical applications, the operating current of a single photovoltaic cell is generally 20mA/cm, and the operating voltage is not very high, only 0.45 \sim 0.5. Therefore, single cell photovoltaic cells usually cannot be used alone. Many single solar cells need to be connected or packaged in series or parallel to form a solar cell module with certain electrical properties. Therefore, a plurality of monocrystalline silicon photovoltaic solar panels together into blocks, solar photovoltaic power generation group rated power is about 30W, and 4 of these modules in series are fixed on the bracket forming a photovoltaic array, to achieve effective photoelectric conversion.

2.3. Battery Part

The battery is the wind generator and the solar photovoltaic power generation and electrical storage device between the power supplies provides a balanced, long time for the whole system [8-10]. The experimental device is a 12A battery, lead-acid battery 20V. Due to the change of DC-AC output of the inverter is used on DC switch into AC power by using electronic components then, with the function of transformer. The PWM inverter of the experimental device has a rated power of 300W, a current of 0.9A, and an input DC voltage range of 10 to 15V, which outputs sinusoidal alternating current, and the voltage is (230 + 10) V, and the efficiency is over 80.

3. Design of Data Acquisition System for Lower Computer

With the development of computer technology, especially the technology of single chip microcomputer, more and more singlechip computers are used to detect and control some industrial control systems such as temperature and humidity. The PC has a strong monitoring and management functions, while the microcontroller is rapid and flexible control characteristics, communication machine through the PC RS232 serial interface and peripheral equipment, communication is a common solution of many measurement and control system, has very important significance to realize the communication between PC and MCU.

The data acquisition system of the slave computer takes MCU controller as the core module. It realizes the important control function of photoelectric conversion, wind power conversion, information display and circuit protection. The hardware circuit can be divided into two main parts, the main electric circuit and the control circuit. MCU requires bus built-in, strong anti-interference ability. Under the support of the program, all kinds of voltage, current data and state data are collected and processed in time. The corresponding function module is controlled by the corresponding peripheral circuit, so as to ensure the smooth work of the whole experimental device. A series of functions such as voltage detection, current detection, protection circuit, control of driving circuit, and output of display circuit and so on are completed. Figure 2 is a

![Figure 1. The equivalent circuit of solar photovoltaic cell](image)
schematic diagram of a circuit system that controls the system in wind and photoelectric conversion parts.

![Figure 2. Block diagram of control system](image)

3.1. Hardware Component
The whole system consists of the micro controller, the display module, the analog to digital converter module and the electromagnetic relay control module. The modular design has good expansibility. Users can choose modules and components to form practical systems according to application needs, and also increase the functions of corresponding peripheral modules. Based on modular hardware design, the compatibility between modules is realized through the design of an effective data comparison system. In the software implementation, it can achieve a variety of functions to replace part of the hardware circuit using single-chip programming, and the system can be modified, which improves the stability and price.

3.2. Software Part
The controller software is programmed by 51 MCU C language, including main program, system initialization program, signal acquisition A / D conversion program, automatic tracking control subroutine, battery charging and discharging control program, keyboard and display subroutine, etc. The communication protocol between the host computer and the lower computer can use different communication protocols. It can have RS232 serial communication or RS485 serial communication. When using computers to communicate with PLC, they can not only use traditional D form serial communication, but also adopt PROFIBUS-DP communication which is more suitable for industrial control. When communication between computers and single-chip computers is usually based on RS232 serial port communication, users can write their own driver's class interface protocol program according to serial communication protocol to achieve communication between host computer and slave computer. The main program is used to cycle detection and control of the whole system, and the signal acquisition sub program completes the acquisition of solar angle, light intensity, temperature, voltage and current parameters. The main program flow diagram is shown in Figure 3.
4. Conclusion
In this paper, a data detection system for wind and solar complementary power generation devices based on communication between upper and lower computers is proposed. Based on the summary and analysis of existing works, the data acquisition and reception of intelligent wind solar hybrid power generation devices are mainly studied. The core of the whole design is the communication between the upper computer and the lower computer. Modular design and intelligent management enhance the scalability and reliability of the wind and solar hybrid intelligent device, and effectively extend the battery life.

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