The Establishment of Distributed Photovoltaic Power Station Data Collection System

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Abstract. The massive access of distributed photovoltaic power station poses a great challenge to the safe operation of the power grid, and the real-time and accurate data transmission is the first trouble to be solved. In this paper, through the establishment of distributed photovoltaic power station data collection system, a set of voltage transformer and current transformer are used to collect data on scene, through middle register at the same time guarantee the data synchronization, through the AD converter is converted to a digital signal after through the WiFi or GPRS data transmission based on conditions in the field. A distributed photovoltaic power station in Jincheng area as an example, it represents that the system has a certain advantage in data real-time, accuracy, overcome the previous system synchronization, real-time data transmission and low accuracy of shortcomings, at the same time in many related power grid applications have a certain role in promoting.

1. Introduction
With the access of a large number of civil distributed photovoltaic power stations, the supply and transfer of power supply to the grid and the operation of the power grid will have some impact. In a low-voltage grid, the effect is even more severe [1]. The power of the 0.4kv power grid has changed from a single power supply downward to a two-way flow. The power supply of the residential area is converted from the 10kv side powered by a transformer to reducing power supply and waving the rest of the power supply in parallel. The transformation of the power supply and the absorption mode, the change of the direction of the low voltage power flow, will affect the power grid. In a low-voltage grid, the effect is even more severe. At the same time, a large number of distributed power stations are widely dispersed and connected to the grid power generation operation. Moreover, it is impossible to know the impact of the situation on the power grid due to the poor performance of the local capacity. If you want to study the actual operation, you need to know all the data in the actual operation, at present, there is no data acquisition condition of low-voltage photovoltaic platform. The photovoltaic operation platform can only transmit power data. Although some conclusions can be drawn, the research needs cannot be satisfied. Provided that you want to do a study, you must need data capturing real-time change, a period of operation, the operation of typical cases at an important point in time, the operation of the special circumstances, the data for statistics, clustering, contrast, composition, discrimination analysis, inductive and deductive method, the conclusion and verify the conclusion, and the real-time voltage. But electric current change data is difficult to obtain in current conditions, compound collecting waste human inefficient cannot implement, to existing power acquisition
terminal equipment to implement area power distribution network real-time acquisition of field and on-site environmental requirements are large, and the cost more [2]. Therefore, it is imperative to establish a data acquisition system.

According to the above issue, this paper puts forward a set of high efficiency, simple system to complete the regional electric power data real-time acquisition and back, at the same time to simple analysis, summary of data, graphics, tables, the results for further analysis.

2. Status analysis
The access of a large number of distributed photovoltaic power generation, especially in rural areas, is hard to predict. Irregular rural power load, are greatly influenced by season and holiday, meet the busy farming or the feast, the daily load and power consumption, and in the usual in the afternoon, a variable and may be empty or nearly empty state. This paper takes a rural area in jincheng, Shanxi Province as an example.

![Graph](image)

**Figure 1.** Power generation of photovoltaic power station in Taiwan and the simulation diagram of the absorption of electricity.

**Note:** The simulation model simulates a 30 households of natural villages, with a photovoltaic installation of 20kWp, and the typical situation of the generation of young people working on a sunny day in a sunny day. Red is the change of electricity generation in the whole day, blue is the power network situation, mainly for home appliances and simple agricultural processing load.

From figure 1, it is concluded that the power generation peak from 10a.m. to 3p.m., with a relatively large portion of the electricity, is difficult to be consumed in place, and the voltage is increased by the transformer into the 10kV power grid. In some mountainous areas or more remote areas, most of the electricity is sent to the high-pressure side because the main labor force is already out of work.
Figure 2. The power generation of photovoltaic power station in Taiyuan area and the simulation diagram.

Note: The simulation model simulates a 30 households of natural villages, with a photovoltaic installation of 20kWp, and young people who go out to work for 30 days of the whole month. During the period of 7 days, the power generation efficiency will be calculated according to 70% of sunny days, 3 days overcast, and the power generation efficiency will be about 50% on a sunny day. The electricity is used for daytime.

From figure 2, it is obvious that the power supply of low-voltage distribution network is very obvious, which will bring a lot of adverse effects on the safe operation, power quality and equipment of the low-voltage platform [4]. The above analysis is based on the ideal simulation analysis. Accuracy can only be analyzed if all the Internet and all in place are eliminated. When local consumption and generating electricity are random fluctuation by external factors, the simulation analysis will not be able to accurately reflect the change, the analysis of the results and will be a big gap between actual operations in reality, a lot of problems is difficult to reflect. In this paper, a distributed power station data acquisition system is established to obtain real-time and accurate operation of the platform.

3. System introduction

3.1. DAE (Data Acquisition Equipment)

The data that distributed power station needs to collect has: the real-time voltage and current of power generation and electricity in photovoltaic low-voltage platform, voltage on the low side, direct collection method is adopted for current collection. The system adopts the conventional data collection method to collect data, and the current transformer and voltage collecting element are installed in the circuit. The current transformer is not directly connected to the power grid system. Through high impedance circuits and power grid voltage transformer phase and furnish controllable protection device, ensure acquisition circuit fault does not affect the power grid operation and ensure the real-time and accurate dynamic data collection grid.

Install voltage transformer and current transformer in the area that need to be collected. In order to ensure the safety of the low pressure side and do not affect the equipment and the platform, the current data is collected by the heart current transformer. After the transformer is fixed, the insulation cable shall pass through the transformer center without touching. The voltage data is collected directly and the phase voltage of each phase line is collected.
3.2. Data conversion and transmission equipment
The data collected by the data acquisition equipment needs data conversion, transmission to use and play value. Since the original voltage and current data are analog signals, they need to be converted into digital signals for transmission and analysis. Therefore, the system USES a universal digital analog conversion device to convert the original analog data into digital data for use by the terminal system [3].

Has a wide distribution due to the distributed photovoltaic power station, collecting device is more, in order to ensure that sampling of sex at the same time, the field sampling equipment must have stable and the right frequency clock circuit, using an intermediate between register, will be sent to the sampled data in the same time focus after staging sent to central processing equipment, and then unified data transmitted to receiving terminal.

4. System design
The system USES a set of current transformer and voltage transformer to collect raw data, and then transfer the secondary value of the transformer to the processing chip after the analog-to-digital conversion (solid Dewey). This system processing chip is a solid, a 32-bit arm chip, the chip has convenient digital to analog circuit design, with a minimum of 4k internal FLASH ROM and 1m, can also be a peripheral storage interface and memory chips, and integrated communication processor, can cooperate with different terminals in the processing of data transmission, at the same time, running low requirements for environment, running stable, fast, sensitive data processing, high reliability, can satisfy the operation demand of the system and can ensure that a variety of sampling data at the same time.

This system data transmission adopts the two ways, one is to use the WiFi transmission, using photovoltaic (pv) family has its own conditions, through the wireless router to connect antenna and home, and then the transmission of data to the inverter manufacturer of public data center; In the absence of WiFi transmission conditions, GPRS is used for data collection and transmission.

5. Test
This article selects shanxi jincheng linze area, the village photovoltaic access 3 subscribers, area and 200kva and installation for more than a month since the electricity to users and given the data collection, in October, a few typical case:

![Figure 3. Weather conditions of jincheng district in October 2017.](image-url)
The northern part of October is a rare and rainy day. For the rural area, it is not the peak of summer peak and the winter peak of heating, but due to the rare rainy weather, the data of this month can be collected and studied as a typical month. Climate change will not only affect electricity generation, but will also change the production and life of rural residents and changes in travel, affecting electricity consumption. Based on a typical day, or have the characteristics of the typical month period of power analysis, can grasp the running rule of photovoltaic power station not only, also can grasp the electricity law of the masses of users, combined electricity and power generation.

![Figure 4. Photovoltaic power station in the Taiwan area.](image)

**Note:** the picture shows two homes on 2 October 6 that day - 21, the change of the power generation and power curve, October 2, sunny day all day that day, the temperature of 12℃ - 26℃

![Figure 5. The power generation of photovoltaic power station in Taiwan area and the situation diagram of consumption.](image)

**Note:** the graph is a home on October 23, and another door on October 24, 6 -- 21 when the change of the power generation and power curve, the average daily for a rainy day, temperature is 6℃, the highest 12℃.
Figure 6. Power generation of photovoltaic power station in Taiwan and the picture of its consumption.

Note: This figure is two door on October 18, July 19 at 6 to 21, the change of the power generation and power consumption of the graph, the two day is cloudy, the temperature minimum 13℃, the highest 22℃.

Figure 7. User's electricity generation and electricity consumption in October.
Figure 8. User b will generate electricity and electricity consumption in October.

It can be seen from the comparison between the above and the software simulation that it is a smooth curve, but it is difficult to produce a smooth curve in real power generation. It is also very different from the actual operation data to produce the irregular power generation curve due to the subtle influence of the weather on the rainy weather of software simulation. In the same area, two users are not far from each other. Due to different components, inverter power supply, installation mode, maintenance frequency and maintenance degree, there is also a gap in generation of power generation at the same time.

Through the analysis and comparison of the preliminary data, the real-time, continuity and accuracy of the data meet the relevant standards and requirements, which are consistent with the on-site situation. Through the establishment of distributed photovoltaic power station data collection system preliminary solved the previous distributed power operation in the process of data collection are not synchronized, incomplete, real-time character shortcomings, for the subsequent related application provides real-time and reliable data.

6. Conclusion
As a research object in a photovoltaic platform in jincheng, the system in this paper performs well in transmission efficiency and accuracy. The system has the following characteristics: 1) it has a good promotion effect on the supervision and research of the anti-transport situation in the Taiwan area; 2) it can help improve the daytime voltage drop in the photovoltaic platform; 3) it is of guiding value for power distribution and load forecasting; 4) it can realize the security auxiliary monitoring during maintenance of the Taiwan area; 5) realize real-time monitoring of users; 6) can be used as the basis for power recovery.

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