Application Study of Intelligent Agricultural Photovoltaic Power Generation Tracking System

Yitong Niu
Faculty of Electrical Engineering
Belarusian-Russian University
Mogilev, Belarus
itong_niu@163.com

Andrei Korneev
Faculty of Electrical Engineering
Belarusian-Russian University
Mogilev, Belarus
AnKorn79@mail.ru

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***Abstract*—In this paper, from the perspective of photovoltaic agriculture, the use of intelligent equipment to achieve real-time tracking of the sun's rays, so that the power generation of solar rays at any moment to ensure maximum power generation, stable energy basis can further improve the rest of the agricultural needs of the field, the use of electrical energy mining groundwater or reservoir water resources for agricultural irrigation, in the establishment of intelligent control systems for greenhouses in the temperature, brightness, gas concentration and other parameters to do further regulation, adjustment to meet the most suitable growth environment for crops, real-time to improve the crop needs of a variety of substances, to improve crop yields and their quality.**

***Keywords*—Photovoltaic power generation; Sustainable agriculture; Tracking system.**

I. INTRODUCTION

In the field of electrical energy manufacturing, thermal power and hydropower, the two major sources of electricity, have been the most dependent on human society, from the time of large-scale mining of electricity, water, and firepower almost accounted for the power field. And photovoltaic power generation started late, the initial application is limited to the power generation industry, and then solar energy in the field of street lights to break out of the cocoon, the use of solar panels to store electrical energy to power street lights, and then solar energy is more widely used in daily life, such as home solar appliances, solar green cars, etc., in the field of aerospace has a seat. In fact, regarding the application of solar energy, many experts and scholars also proposed that it can be expanded in agriculture. The use of solar energy plus agricultural production, to achieve solar energy industry and agricultural planting industry of dual innovation, is a better research direction. Photovoltaic eco-agriculture can not only save a lot of land resources but also maximize the use of the sun's light and heat resources to heat the greenhouse, thus the normal production of crops [1]. Through the support of solar energy, the required land area is greatly saved in face value, and the intelligent tracking system of photovoltaic power generation is used to achieve the most value of solar power generation, according to which a set of solar agricultural intelligent control systems is developed to realize agricultural intelligence and improve crop yield as well as quality.

II. PHOTOVOLTAIC SMART TRACKING CONCEPT

Photovoltaic power generation can effectively solve the problem of power supply in areas without electricity and is used in water irrigation, fish pond oxygenation, desert management, grassland animal husbandry, and other fields [2]. How to greatly improve the efficiency of photovoltaic power generation with limited area, material, and equipment. A set of the solar energy-intelligent tracking device can be designed, the principle of which lies in the application of photoelectric sensor can be based on the application of light dim a tracking module, for example, can be used as a photoresistor light signal capture element, the use of photoelectric characteristics of the photoresistor, the perception of light, the development of photovoltaic tracking system based on the signal acquisition module. For the working theory of photoresistors, certain substances absorb the energy of photons and produce intrinsic absorption or impurity absorption, thus changing the phenomenon of the conductivity of the substance is called the photoconductivity effect of the substance [3]. The unique perceptual characteristics of the photoresistor to the intensity of light, its photoelectric properties lie in the inverse relationship between its resistance and external light, the stronger the light intensity, the smaller its resistance, so that it can produce the corresponding The stronger the light, the lower the resistance so that the corresponding signal can be generated to complete the pursuit of light, the photoresistor circuit diagram is shown in Fig.1.

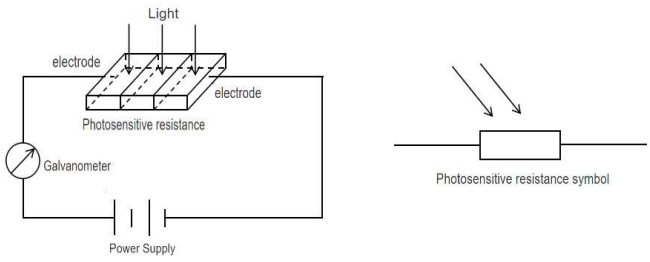

Fig.1. Photoresistor circuit diagram

In the solar power generation system, a photoresistor is added and a stepper motor is used as an output actuator to drive the solar panel to track the sun rays. In how to build a solar photovoltaic power generation intelligent tracking system, the concept is shown in Fig. 2, in the tracking of solar panels, the addition of solar light signal acquisition device, the whole system includes central processing system (here you can use small size, processing information fast, high accuracy, long life and other advantages of the microcontroller processing), stepper motor, solar panels, composed of a unified photovoltaic tracking system.

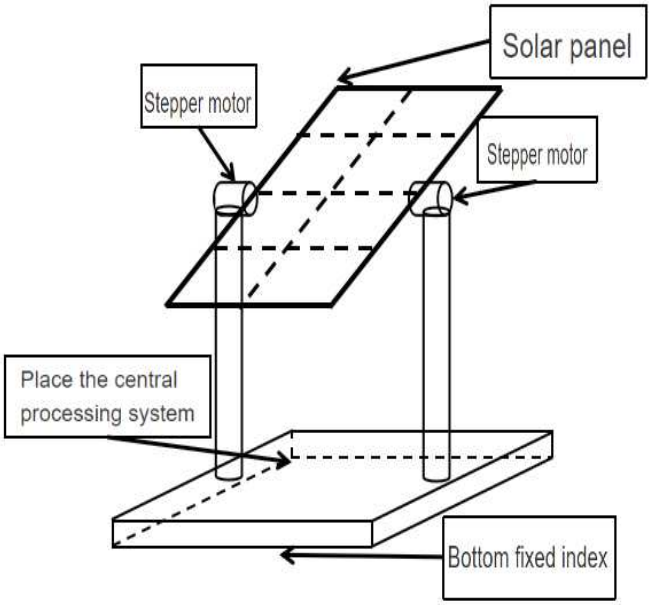

Fig.2. Conceptual diagram of photovoltaic intelligent tracking theory

In the field of solar photovoltaic power generation intelligent tracking, the main thing is to ensure that the solar panel in the light of the sunlight, do real-time visual sun movement (similar to the sunflower chasing effect), to ensure that the solar power generation to reach the maximum, to ensure sufficient agricultural electricity. In terms of the power output of solar electromagnetic panels, solar power generation is DC power, so for some DC power appliances, they can be used directly, so when it comes to agricultural power for AC power, there is also a need to do further processing of solar DC power, according to this, the power generation system can be built in large quantities in the idle places of farms, and the power generated will be rectified and inverted for application in agricultural development.

In the process, of crop growth, cannot be separated from the appropriate light, and soil and humidity. which is very important for plant growth factors only by workers' experience, this is not conducive to large-scale scientific planting of agricultural products, so the design of intelligent agricultural greenhouse on the growth of crops and save manpower and material resources to play a key role [4]. So, agriculture can be through the construction of the greenhouse, through electricity to improve the required energy, by the computer control system (can be used integrated circuit microcontroller act as) to regulate the intensity of light; adjust the crop growth environment humidity; agricultural greenhouse carbon dioxide concentration; promote the photosynthesis of crops, to achieve in a limited geographical environment, the purpose of a large number of crops to increase production. In irrigation, the construction of solar photovoltaic water lifting system [5]. In the treatment of pest prevention, pests can be suppressed by different lamps emitting light at frequencies inappropriate for pests, but of course, this is done under the premise of not harming the plant. Further. Solar photovoltaic power generation tracking intelligent system is as the basis of intelligent agriculture, based on solar power generation as an important energy source for the development of the whole agriculture, to achieve the artificial regulation of agricultural production, break the original agriculture by the climate, geographical restrictions, the full realization of agricultural intelligence.

III. Research on Solar Photovoltaic Agricultural Scheme

In order to maximize the economic efficiency of light-compensated photovoltaic agriculture that combines photovoltaic power generation with agricultural production and to maximize its application value, this paper describes an application of solar energy photovoltaic farming scheme.

To maximize the efficiency of light utilization, the stereoscopic planting + greenhouse planting model is used in agricultural production. Stereoscopic planting mode can produce more crops in a limited area of land. For artificial blue-violet light source and red light source, which are point light source, the light of point light source is diffuse, stereoscopic planting can better absorb the light. The greenhouse planting mode can effectively control the temperature and humidity of the growing environment of crops, and also effectively reduce the evaporation of water. In the solar equipment of photovoltaic power generation, the installation of power generation equipment is not suitable for large areas to be built so that the crops can absorb enough light for photosynthesis. Efficient solar tracking system is very critical. The purpose of using solar power generation is to store solar energy in the form of electrical energy first, and then when the light reaction stage in photosynthesis lacks light energy, the electrical energy stored in the battery will be reconverted into blue-violet and red light through red, blue and purple lights to provide light energy for plant photosynthesis.

To provide enough electrical energy to support the hours of light compensation, the capacity of the electrical energy storage device (capacitor) should also be large enough. As shown in Fig.3, what is conceived in the figure is the structure diagram of smart agriculture with PV power generation as an integration. Various sensors are installed to detect the parameters inside the greenhouse and transmit the data to the computer control system to achieve the overall intelligent control of CO_2 concentration, temperature, light intensity, soil moisture, etc. in the greenhouse, thus achieving the production effect of intelligent agriculture. Based on the ladder structure of 3 and 4 in Fig.3, we can develop three-dimensional agriculture in space to maximize the use of

land, and we can also develop soilless crop cultivation based on this, by mixing the nutrients needed for crop growth in the irrigation water and using the PID control method of the computerized intelligent system to regulate the flow of water, to replace the water in the roots of crops on time from week to week, thus To ensure that the crop roots are not exposed to too much water due to waste, resulting in root necrosis, to ensure the healthy growth of crops.

In general, through the human subjective, the crops grown under natural conditions, through the establishment of a greenhouse, the external growth environment of crops to make regular regulation, the external environment in line with the growth environment of crops, and all of this will be through the computer control system for the deployment of processing, through intelligent regulation, can provide the most suitable growth environment for the growth of crops, and in this basic, reduce Labor costs, because the light energy required for plant growth, the electrical energy required for the control system, the operation of the greenhouse energy is from photovoltaic solar energy, in theory, photovoltaic solar greenhouse energy can reach self-sufficiency, greatly saving agricultural production costs.

IV. PHOTOVOLTAIC POWER GENERATION IN AGRICULTURE

The use of solar power generation to achieve irrigation systems in agricultural fields, solar temperature detection in the greenhouse planting, intelligent control of photovoltaic power generation greenhouse planting, solar pest control lamps (solar pest control), etc. The insect trapping lamp uses insects tend to light to produce reaction behavior, with the corresponding wavelength of light waves induced to the high-voltage power grid and another kill, high-voltage power grid around the insect trapping lamp, when the flying insects are lured by the light will fly to the lamp, before approaching the lamp first encounter high-voltage power grid, the instantaneous high-voltage electric shock will directly kill them, after killing the flying insects fall into the tray and concentrated in the catch bag, to complete the killing of flying insects [6]. In this way, the insecticidal operation is completed, reducing the use of insecticides and opening up green agriculture.

As shown in Fig.4 is the schematic diagram of the solar energy-based agricultural intelligent regulation system, in which the required energy comes from solar panels, based on the photovoltaic power generation intelligent tracking system, to achieve the maximum limit of solar power generation, the generated electricity is directly applied to the solar energy-based agricultural intelligent regulation system and agricultural products processing. And the remaining amount of electricity can be stored using the battery for grid connection or, depending on local conditions, building small pumped storage power stations to store the electricity.

Among them, the computer intelligent regulation system, the agricultural shed as the control object, the agricultural shed in the temperature, light brightness, air moisture content, and other corresponding amounts for the regulation system of the adjustment parameters, can be adjusted by the intelligent control system of the proportional integral differential regulator (PID) to achieve a variety of parameters in the agricultural shed for the production of crops the most suitable environmental factors. Of course, each crop is different, and its production environment also exists in different growth environments, in the process of system design, a new type of solar-powered solar-powered glass film greenhouse was selected. This new type of greenhouse replaces the original plastic film with photovoltaic glass film, and changes the south wall of the greenhouse into a solar panel, making full use of the results of the photovoltaic industry,

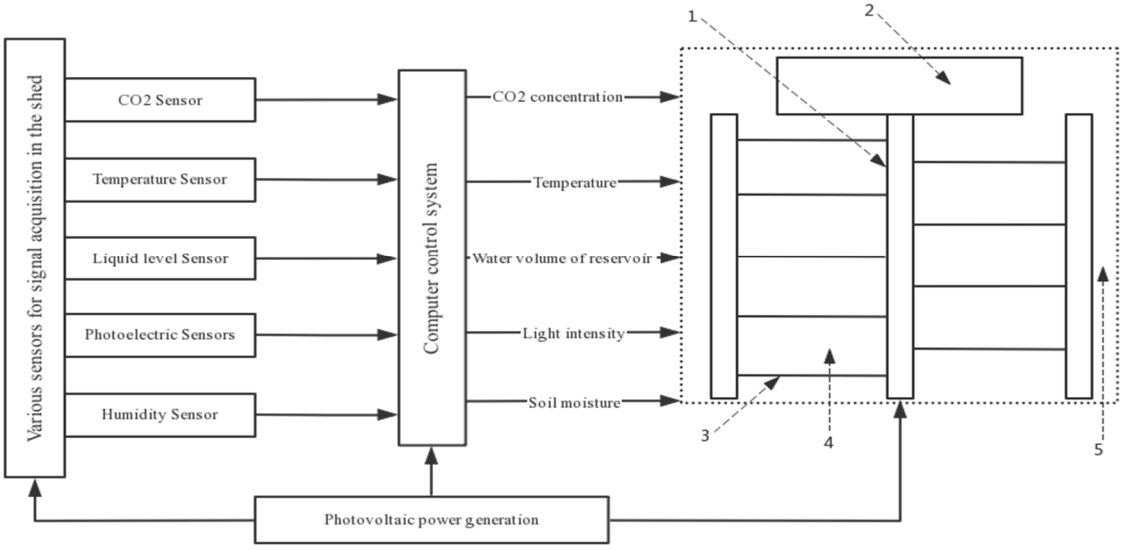

Fig.3. Smart Agriculture Structure Chart (1- Irrigation conduit (can be mixed with water and fertilizer to achieve fertilization and irrigation in one agricultural irrigation); 2- Cistern; 3- LED plant lights can be laid to ensure photosynthesis; 4- Plant cultivation; 5- Greenhouse greenhouse)

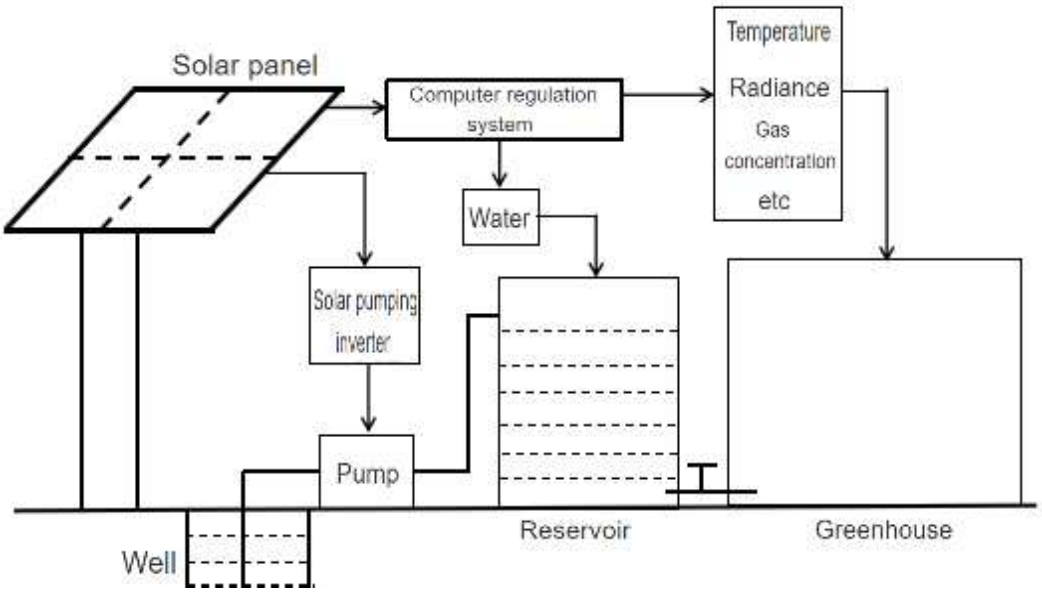

Fig.4. Agricultural intelligent regulation system diagram based on solar energy

making the organic combination of photovoltaic industry and agriculture, environmental protection and resource utilization compared with the traditional plastic film greenhouse improvement progress [7]. Therefore, the design of an agricultural greenhouse in the seeding of crops should be adjusted by the computer when setting the required parameter conditions. This will greatly improve the use of space in the greenhouse and increase the yield of crops [8].

V. CONCLUSION

Food and crops are the basis of human survival, since ancient times there is the proverb that people are food for the day. The importance of crops speaks for itself. And for the beginning of the year 2020, natural disasters are frequent. The world food problem caused by the locust plague is very serious. In this paper, from the perspective of intelligent photovoltaic agriculture, the development of a light-compensated photovoltaic + agriculture model to achieve an intelligent agricultural photovoltaic power generation tracking system to facilitate the growth of crops and improve crop yields, which can alleviate the problem of food shortage to a certain extent. The model extends the application of PV in agriculture, promotes the development of the PV industry to a certain extent, and also provides a solution for high yield in agriculture.

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