

# Research on Intelligent Irrigation and Fertilization System In Greenhouse Based on Cloud Computing

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**Abstract.** In view of our country of precision fertilization device mainly depend on import, automatic fertilizing device and the actual market needs a serious gap between the status quo, this paper combines the PAC technology, proposed the classic model of agricultural water and fertilizer management, controlled by the central, lower computer, actuator, sensor is composed of four parts, the classic model makes full use of the advantages of PAC technology, such as the identification of general-purpose programming language, PC machine hardware and software resources are rich, flexible communication mode, can use the rich information resources management. In this paper, by using this model, the design and implementation of three systems, one is the automatic control system of deep liquid cultivation, two is the small size intelligent drip irrigation system, three is a multi-threaded irrigation thought realizes the construction of agricultural information Park medium scale, through continuous improvement and perfection, successfully extended to a PC corresponding to a plurality of slave machine, formed from the structure. Through the test of practice, the system of flexible assembly, strong expansibility, low cost, easy popularization, out of a road of independent innovation, has made an attempt and efforts for national agricultural informatization.

## Introduction

At present, modern agricultural technology more advanced countries, Israel, Holland, France America in Israel, such as the most popular word is "we only to fertilize the crops to drink water, but not to the land ", it reflects the advanced idea of their water and fertilizer in the planting process application management in America, using nutrition; liquid filling a separate storage compound, and then through the computer to realize the different proportion of mixed into nutrition liquid, feed to the root of the crop in the nutrient solution, and constantly on the nutrient composition were analyzed, and then returned to the computer for correction formula; and the Holland A-B type system, representing no advanced technology of soil cultivation, according to online monitoring nutrient solution EC value and pH value, then according to the mother liquor added deployment; the French agricultural facilities mainly concentrated in soilless cultivation in greenhouse, DOSTRON fertilizer pesticide mixer and its development and production of today on behalf of the international leading level.

Generally speaking, at present our country in the research of agricultural water fertilizer management mainly focus on the soil water adjustment, and the research for integrated management of water and fertilizer application has extended from less, the integrated management of water and fertilizer project, not the formation of products, the degree of automation science is low, manual

operation basically belongs to the extensive, but relatively large greenhouse the basic use of the off the shelf equipment and technology from abroad, so the state began to support independent innovation, drip irrigation and fertilization intelligent device to study a set of low cost, easy popularization and become the development direction of precision agriculture in China.

### **The steps of software development of PAC control**

When the hardware platform of the automatic control system, began compiling work. Design of programmable automation control system can be. Mainly carries on the program design according to customer requirement and function of equipment operating instructions. Program design is substantially completed by the following nine steps:

(1) understanding of the system requirements. To communicate with users, combined with the production of their needs and suggestions, writing user requirements specification, and lays out a system diagram;

(2) with hardware system. According to the PAC design idea, design of supporting software and hardware platform, through the market to buy the right products, using the familiar single product description;

(3) familiar with the programming environment and language. The choice of a good programming environment and programming language, such as VS2008+C#;

(4) calls the function test of single intelligent equipment. Cooperate with related function, selection of intelligent equipment for single function module test;

(5) the logical framework design and system design. According to the system function diagram, the whole software framework design, logic design and part of the core functions.

(6) programming. The preparation of the code in the choice of good programming environment.

(7) software system testing. Interior building the hardware platform, simulation test on the control system of writing good, and check the stability of system operation.

(8) the site installation and field test. After the indoor test is completed, moved to the site for installation, and the final field tests;

(9) delivery system and written instructions.

Programmable automatic control system of writing and testing has its unique advantages, its writing and testing can be completed in the same PC machine, and finally the seamless delivery, but the traditional PLC system establishment, must carry on the computer programming and debugging, and then copied into the online testing in the PLC controller.

### **The Modbus protocol**

Modbus is composed of Modicon (now a brand of Schneider electric company) invented in twentieth Century at the end of the 80's, as the world's first industrial control bus protocol, widely used. The Modbus protocol defines the message structure uniform, whether they communicate through what way, can be identified by the controller. It defines how to access other devices, also defines how to respond to K requests his equipment, which realizes communication between devices, in order to ensure the communication security and correct, it made public format message field pattern and content. This protocol supports the traditional RS232, RS-422, RS485 and Ethernet equipment. Many industrial equipment, intelligent instruments are in the use of the Modbus protocol as the communication standard between them.

The traditional deep liquid cultivation field mainly by the culture tank, Chu Cunchi, Shuisu and connection pipes and manual valve, the specific layout as shown in Figure 3-1 71<sup>^</sup>. The culture tank

6, built in the surface, the basic parameters: length 564cm, width 38cm, high 20cm, volume 0.43m<sup>3</sup>; storage pool built in underground, facilitate nutrient solution culture groove can smoothly return under the action of gravity, the basic parameters: length 588cm, width 79cm, deep 105cm, volume 4.88m<sup>3</sup>; its the size of only one condition: storage tank volume greater than 6 culture tank volume and. In addition to the scene, the traditional deep liquid cultivation smoothly also need major materials and equipment are: water soluble fertilizer, planting foam board, handheld EC meter, pH meter. The operation steps are as follows:

The first step: according to the nutrient solution formula and the required nutrition liquid volume, weighing a good water soluble fertilizer, and then melt mixing together in the storage pool;

The second step: the nutrient liquid using diving dishes will be configured to draw the cultivating groove;

The third step: transplanting seedlings, and fixed in the colonization of foam board;

The fourth step: a cycle later, measurement of nutrient solution EC value and pH value, and make a record, open training manual wide slot door, will return the old nutrient solution to the storage pool;

The fifth step: according to the EC value and pH value of record, if the concentration of the nutrient solution decreased, pH and nutrient solution is added to supplements nutrient liquid;

The sixth step: the nutrient solution by submersible millet will configure good pumping into the culture groove (the beginning of the next cycle, until crop maturity).

Time rotation of nutrient solution, all need to waste is in nutrient solution and link Shuisu reflux extraction of nutrient solution. Long time, and it is a cycle repeated process, taking into account the cost of labor, the traditional training cycle of deep liquid cultivation are arranged generally a week or longer, but from the roots of aerobic perspective, this cycle is not a reasonable value, in order to prevent bacteria infection, the shorter the beneficial cycle of rotation on the growth of crops, but it will consume too much artificial management costs, therefore, it is very necessary and hair nutrition liquid automatic rotation and monitoring system, it can collect continuous consumption data of nutrient solution, provided the conditions for the study of the process of crop growth and nutrient demand relationship.

## Experiments and results

In the condition of rotational speed  $n$  between 1000 r/min and 2400 r/min, throttle opening  $\alpha$  between 30% and 100%, fuel consumption characteristic curve of ECPE is as shown in Fig.1. In the conditions of specific rotational speed, fuel consumption rate increases with the increase of the throttle opening.

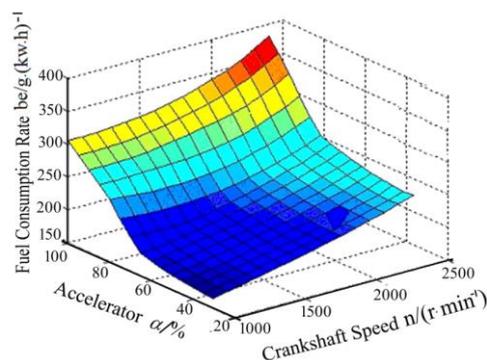


Figure1. Fuel consumption rate

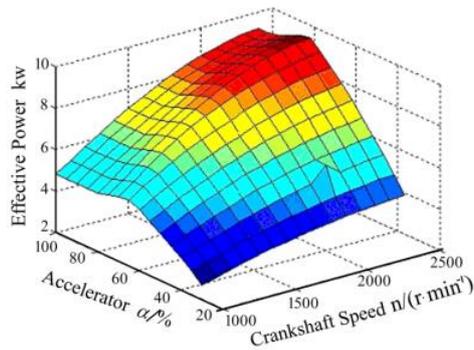


Figure 2. Effective power characteristics curve characteristics curve

Effective power characteristics, In the condition of rotational speed  $n$  between 1000 r/min and 2400 r/min, throttle opening  $\alpha$  between 30% and 100%, the effective power characteristics curve of ECPE is as shown in Fig. 2. The effective power increases with the increase of rotational speed.

Running unevenness characteristics, In the condition of rotational speed  $n$  between 1000 r/min and 2400 r/min, throttle opening  $\alpha$  between 30% and 100%, the running unevenness characteristics curve of ECPE is as shown in Fig.3. The running unevenness markedly decreases with the increase of rotational speed and is little affected by the throttle opening.

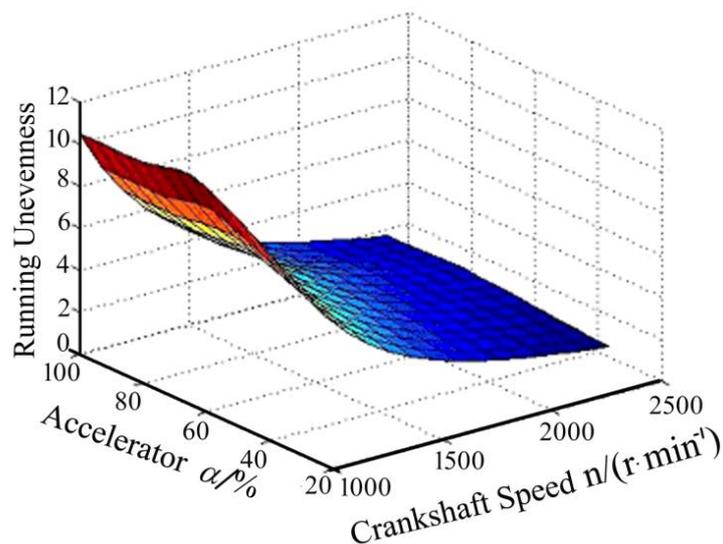


Figure 3. Running unevenness characteristic curve

## Conclusion

Whether it is used in deep liquid cultivation, or in application to field planting, irrigation and fertilization technology of intelligent demonstrated the unique charm. However, compared to China's domestic intelligent irrigation and fertilization technology, can be found still exist a large gap with foreign advanced technology, the more inspired us to development and promotion of intelligent fertigation equipment to meet the development of modern agriculture in china. This research in view of the actual demand of domestic irrigation and fertilization, taking PAC technology as the core idea, used PC as control center, programming the control system with the language, through the optical fiber transmission of the control command, control of intelligent equipment linkage and orderly movement, construct a set of flexible structure, low cost, simple operation, can develop the intelligent irrigation and fertilization system strong. This set of system from the hardware platform, and then to the automatic control system to prepare, without relying on foreign technology, out of a road of independent innovation, as long as a little change can satisfy the

deep liquid cultivation and field cultivated species of intelligent irrigation water and fertilizer.

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