Agricultural Machinery Automation and Intelligent Research and Application

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Abstract. The level of intelligent and automation of agricultural machinery has become an important indicator to measure the development of contemporary agriculture. In order to meet the needs of the development of modern agricultural machinery industry in China, it is necessary to strengthen the construction of China's agricultural mechanization level in order to improve rural economic development and solve the shortage of rural labor. The paper will discuss how to integrate advanced information-based intelligent equipment into the design, manufacturing, operation and management of agricultural machinery, and use the orchard intelligent herbicide as an example to analyze the collaborative design of knowledge engineering agricultural machinery product design and product data management. The key technologies and processes are analyzed, and the existing dramatization and intelligence deficiencies are summarized. By drawing on the mature technology of developed countries, we find the core of the problem and indicate the development path for the automation and intelligent of agricultural machinery in China.

1. Introduction

In many fields in China, the use of mechanical automation technology is involved, which helps to save the actual production time of the corresponding project, which is beneficial to increase product output, and can effectively increase the economic benefits of users in the later period. At the same time, it is for maintenance. The natural ecological balance has positive significance. At the same time, through continuous research and analysis of agricultural machinery automation technology, China's agricultural planting methods have undergone major changes, specifically, mechanical automation technology has gradually penetrated into the agricultural planting, production, growth and harvesting. It has positive significance for improving the quality of agricultural products. Mechanical automation is mainly implemented by a system consisting of functions, formulation, and program modules, and implements specific control operations. For example, the program module mainly refers to “issuing orders” that is, setting tasks for the system; the function modules mainly refer to adjusting positioning factors, controlling energy input and output; among them, formulating modules is one of the most important components in the system. It can compare and analyze the information generated and involved in the system in real time, and then send out different signals and warnings.
2. Application Status of Information Technology in Agricultural Machinery Design in China

2.1. Agricultural machinery cauterization technology design
Parametric design technology is an efficient design technology that reflects the design intent by parameter adjustment and real-time driving product elements based on product requirements. It is the main content of computer aided design (CAD). With the rapid development of information technology, combined with artificial intelligence technology, parametric design theory has been integrated into intelligent design and virtual design methods. The concept of parametric design has been continuously improved and expanded with the development of information technology. In the research and development of agricultural machinery products, combined with knowledge reasoning, there are a variety of parametric design methods for agricultural machinery products, such as the parametric design of harvesting machinery gearbox [1], agricultural ultrasonic atomizing transducer [2] and so on. Application. Information and knowledge engineering theory promoted the development of parametric design technology and expanded its application in the innovative design of agricultural machinery products. Wang Zongyan et al [3] combined with optimization design, established an integrated data management system, and optimized the parametric design of mechanical structure.

2.2. Precision Agriculture Technology
Based on information technology support for crop science, agronomy, soil science, plant protection, resource and environmental science, intelligent equipment and automatic monitoring, decision support, etc., with the support of GPS and GIS, the "precision agriculture" technology system has been perfected. The system utilizes agricultural machinery intelligent equipment technology to generate crop yield distribution map, crop management database and growth and development simulation model, crop management assistant decision system and crop management prescription map. The fine agricultural technology system is shown in Figure 1.

Figure 1. Agricultural machinery automation and intelligent application in China's agricultural field

3. Orchard intelligent weeder automation program design and application example analysis
The automatic lawn mower is a new type of agricultural machinery developed in recent years, which can realize automatic control of mowing by using wireless sensing technology. The weeding machine
can realize the automation of the weeding machine if it is modified by the Internet of Things technology.

3.1. Introduction to the algorithm
The principle of AOA-based weeder obstacle positioning is shown in Figure 2. The positioning principle is relatively simple, but it is more susceptible to external factors such as noise, and its positioning accuracy cannot meet the requirements of high-precision positioning, so it can be combined with the RSSI ranging positioning algorithm [4].

![Figure 2. The principle of obstacle location based on AOA](image)

The RSSI positioning is based mainly on the intensity of the transmitted and received signals, and the distance from the obstacle is estimated based on the loss of the signal because the signal strength decays as the distance increases during propagation. Its calculation formula is 

$$\frac{P_r}{P_t} = G_t G_r \frac{\lambda^2}{(4\pi)^2 R^2}.$$ 

Among them, $P_t$ and $P_r$ respectively represent the transmitting power and receiving power of the weeder antenna; $G_t$ and $G_r$ respectively represent the antenna gain of the herbier transmitting antenna and the receiving antenna; $\lambda$ is the signal carrier wavelength; $R$ is the signal transmission distance. The distance-based positioning method is susceptible to fluctuations caused by external environmental factors. In addition to the distance-based positioning method, the method of alliteration and maximum likelihood estimation can be used by the Internet of Things technology. The alliteration method mainly uses sensor nodes of many known positions to determine the position coordinates of the position nodes by using the position coordinate simultaneous equations [5].

After inputting the direction in which the weeder is expected to travel, the direction deviation can be adjusted by the infrared sensor according to the distance of the obstacle, and the movement of the weeder can be more accurately adjusted by the feedback adjustment. When the weeding machine is moving, the steering gear can be used to adjust the direction, and the distance of the obstacle in front is used as the deviation for the incremental PID calculation, and the duty ratio of the steering gear is controlled, so that the weeding machine can change the traveling direction by changing a certain angle, to achieve the purpose of automatic control.

3.2. Intelligent weeding machine positioning and obstacle avoidance and weeding
In order to verify the feasibility of the autonomous positioning navigation and obstacle avoidance of the weeding robot based on the Internet of Things technology, the obstacle avoidance navigation experiment of the intelligent lawn mower was designed. At the same time, the mechanical structure of the intelligent mower is designed, and the navigation module based on the node positioning of the WSN wireless sensor network is equipped [6]. The structure is shown in Figure 3. In order to carry out the mowing task, it is necessary to design a special mowing mechanism for the actual situation of the intelligent mower body. In addition, in order to adapt to different lawns, the mowing cutter should also have the functions of height adjustment and blade replacement.
Figure 3. The mechanical structure of intelligent mower

Table 1. The test performance of different communication modes

| Way of communication | Transmission distance/m | Transmission speed/kB·s⁻¹ |
|----------------------|-------------------------|--------------------------|
| Bluetooth            | 30                      | 5000                     |
| WIFI                 | 100                     | 11000                    |
| Electromagnetic wave | 2                       | 12000                    |
| Zigbee               | 150                     | 2700                     |

Based on different communication methods, the transmission distance and transmission speed are different. By comparison, it is found that WIFI has the advantages of long communication distance and fast transmission speed, which can meet the communication requirements. Therefore, WIFI is selected as the communication method.

Table 2. The location error and obstacle avoidance success test

| Test number | Positioning error/% | Obstacle avoidance success rate/% |
|-------------|---------------------|----------------------------------|
| 1           | 2.52                | 98.52                            |
| 2           | 3.28                | 97.26                            |
| 3           | 4.13                | 96.35                            |
| 4           | 3.56                | 97.12                            |
| 5           | 3.22                | 96.38                            |
| 6           | 3.18                | 95.89                            |

It can be seen from the test results that: using the positioning and navigation algorithm, the weeding machine has higher positioning accuracy and higher success rate of obstacle avoidance, which can meet the design requirements of the intelligent weeding machine.

4. At present, the shortage of intelligent automation application of agricultural mechanization in China and the promotion methods

At present, due to the meager profit of food crops, limited scale and insufficient farmers' willingness to use and understanding, the application of information technology is less, and the promotion of information technology is also facing many difficulties, which are reflected in the following aspects:

First, the labor force is too old, the labor force is mainly over 46 years old, and the labor force is mostly middle-aged and older women. Second, among all the labor force, there are few people who can master the relevant knowledge of computer use, and have intelligent agricultural machinery. The labor force equipped with operational skills is also scarce. It can be seen that the labor force in the facility industry generally has a status quo of low aging and information.
Second, the level of education is limited. The rural labor culture level is mostly concentrated in the junior high school stage. There are also some elementary and high school education levels. There is almost no undergraduate education and above. Low education is the general status of the labor force in the industry. In addition, a survey of the working life of the labor force in the facility found that most of them worked for more than 10 years, up to 30 years, and most of them were engaged in facilities work for a long time. The proportion of employees engaged in facilities work was very small, and their ability to accept new things was small. Weak. In summary, the status quo of the labor force in the facility industry is aging, the education level is generally low, and the acceptance of new technologies is weak.

Third, the level of rural agricultural mechanization is not high. The application level of agricultural machinery and equipment is generally low, and the industries such as vegetables, fruits and fruits are basically blank except for the general links such as farming and plant protection. In the link, taking rice as an example, the operation links such as farming, irrigation and drainage, plant protection, and harvesting have basically achieved mechanization. Although the development of planting and drying has been rapid, the overall level is not high, and the agricultural machinery and equipment are more efficient than modern agriculture. There are still gaps in development requirements. For example, plant protection machinery, traditional knapsack sprayers still exist in large numbers, and efficient and safe plant protection machinery equipment such as agricultural drones, self-propelled boom sprayers, etc. are still in the demonstration stage. The construction of smart agricultural machinery is also lagging behind. Although high-end agricultural machinery and equipment such as automation and intelligent have been given certain demonstration applications in agricultural production, the total amount is still relatively small [7].

However, with the reform and development of the industry and the support of the government, the application of information technology is a major trend. To this end, we need to promote from the following aspects.

The first is to strengthen the research and development of agricultural machinery. We will strengthen the synergy and innovation of agricultural machinery, industry, research and development, and coordinate the efforts of universities, research institutes, manufacturing enterprises, and promotion departments to accelerate the research and development of “industrial needs and farmers' urgent use” of agricultural machinery products, and effectively enhance the supply security capacity of agricultural machinery products. The second is to strengthen the research on the integration of agricultural machinery and agronomy. Adapt to the needs of mechanized production, improve variety selection, farming system, cultivation and breeding mode, strengthen farmland infrastructure, especially machined road construction, promote moderate scale operation of agriculture, promote standardized planting and breeding mode, and further improve equipment operating conditions and environment. The third is to expand the team of agricultural machinery practical talents. Relying on agricultural machinery universities, production and marketing enterprises, social training institutions to establish agricultural machinery practical talents education and training base, strengthen agricultural machinery education, vocational skills training and appraisal, accelerate the cultivation of agricultural machinery driving operations, maintenance and other high-skilled personnel and understand production and A well-managed new agricultural machinery professional manager. At the same time, through regular organization of agricultural machinery operations, maintenance and other vocational skills competitions, etc., to stimulate agricultural machinery practical talents to catch up with learning, and constantly improve business skills, to ensure that agricultural machinery and equipment are used, used well, and used effectively. The fourth is to improve the agricultural machinery support policy. We will further improve the subsidy policy for agricultural machinery purchases, encourage the support of qualified localities to introduce the first set of agricultural machinery and equipment introduction and subsidy policies, and carry out pilot projects for agricultural machinery purchase subsidies for agricultural characteristic industries, and gradually incorporate new agricultural machinery equipment suitable for modern agricultural development into the scope of subsidies. Further promote the implementation of government policies for the purchase of agricultural machinery socialization
services, agricultural machinery credit financial subsidies, agricultural machinery comprehensive insurance financial subsidies, and other issues to further solve the problems of agricultural machinery "difficult to maintain", "funding difficult", "insurable".

5. Conclusion
The realization of agricultural machinery automation and the promotion in rural areas of China is inevitable. At present, the level of agricultural mechanization in China is constantly developing, but it has not yet reached the level of intelligence. With the changes in farmers' demand, the requirements of agricultural standardization and large-scale development are also promoting China. The internationalization of agricultural development level, advanced technology and other advanced technologies are indispensable in the design of agricultural machinery. Through the application of automation technology, the automation level, safety and intelligent functions of agricultural machinery are gradually improved, so as to better solve the problem of rural development. Alleviate the labor pressure in rural areas, and also effectively solve the problem of low level of agricultural development technology.

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