Research on application of intelligent robot based on AI technology in agriculture

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Abstract. With the continuous progress of science and technology, artificial intelligence has profoundly changed various industries, and the agricultural field is no exception. As an important part of modern agriculture, smart agriculture is rapidly emerging, creating brand-new formats and opportunities. At present, the development of agricultural industry is also developing in the direction of high efficiency, intensification, precision and intelligence. As an important branch of modern computer science, AI plays an increasingly high role in the development of modern agriculture. The research and development of intelligent robots based on AI technology is becoming more and more mature, and the application fields are becoming more and more extensive. Under this background, this paper analyzes the development of intelligent robots in the field of agricultural automation and its main applications.

Keywords: AI technology; intelligent robot; Agricultural automation.

1. Introduction

China's agricultural development not only provides stable food supply for people, but also plays an important role in supporting the development of related industries, including manufacturing, transportation, warehousing and so on. The associated service industries such as food culture and rural landscape have great development potential. However, the foundation of China's agricultural development: the population situation in rural areas is gradually becoming more severe. Under the background that the proportion of agricultural GDP in China continues to decline, the number of employees of agricultural backbone is also decreasing year by year. According to statistics, from 1996 to 2007, an average of 17,739,800 people moved from rural areas to cities, with a total of 212,879,700 people [1]. In addition, the problem of aging of agricultural population is becoming more and more common. The average age of agricultural population in China is 40-50 years old, and it will reach 50-60 years old in another 10 years [2]. This also makes the problem of agricultural development more serious. It is very necessary to create an easier working environment for agriculture in order to supplement the population who have gradually lost to cities and towns and are seriously aging, let more young people and women participate in agriculture, reduce the burden and work intensity of agriculture, so as not only to reduce the agricultural burden, but also to attract more people who are interested in agriculture but lack relevant experience to start working in agriculture more easily [3].

In order to promote the sustainable development of agriculture, ensure the stable supply of grain, ensure that agriculture plays various roles, achieve the purpose of strengthening the management consciousness of agricultural business entities, enable them to activate the agricultural business environment with their own judgment, strengthen the competitiveness of agricultural products, and play an active role in cultivating new agricultural employees, centralizing agricultural land, and preparing agricultural infrastructure, it is necessary to vigorously promote the research, improvement, demonstration and popularization of new agricultural technologies and methods, and it is necessary to realize agricultural production circulation and information feedback. Therefore, after China's agriculture experienced the development stages of traditional agriculture and modern agriculture, intelligent agriculture came into being.

Figure 1. Agricultural Automation

2. The application of intelligent robot based on AI technology in agriculture

2.1. Application of intelligent robot in picking crops

In picking, all kinds of crops have their own special picking robots. First of all, a professional tomato picking robot is mainly composed of an executive device, an operating arm and a visual inspection device. Wherein the color camera device is used for visual inspection to select ripe fruits. Because the robot's arm is designed to be very long, it can operate in a wide range, so it can effectively avoid obstacles. At the same time, in order to prevent the robot from damaging the fruit during the picking process, the actuator at the end of the robot is also provided with a soft lining, and a corresponding pressure sensing device is installed, so that the robot can pick tomatoes efficiently. In the process of picking, the robot can automatically determine the picking time of tomatoes according to the light sensor and reflector. The picking time of tomatoes lasts about 1.5 s, and the success rate of picking is about 80%. Secondly, picking apples. The robot for picking apples has a fixed design size, and its picking space is about 5 square meters, which is mainly composed of a moving joint and three rotating joints. The final effect is a three-pin pin with pressure equipment. This robot uses electro-optical sensing equipment to identify whether the fruit is ripe or not, and its success rate is about 88%. Moreover, this intelligent robot is also equipped with a fruit collecting device, which not only reduces the damage of fruit picking, but also greatly shortens the time interval from fruit picking to selling, and maintains the freshness of apples. Thirdly, there are picking robots for watermelon, wax gourd and other crops, and their designs also have their own uniqueness.

The general operation flow of the picking robot is shown in Figure 2: under the action of the main controller, the main control board outputs control instructions to the control module, so that the robot with the structure of the robot arm and the crawler chassis can mobilize the mechanical arm to complete the fruit grabbing [8]. After the fruit is grabbed, it will automatically enter the collection device to minimize the damage of the fruit and ensure the freshness of the fruit.

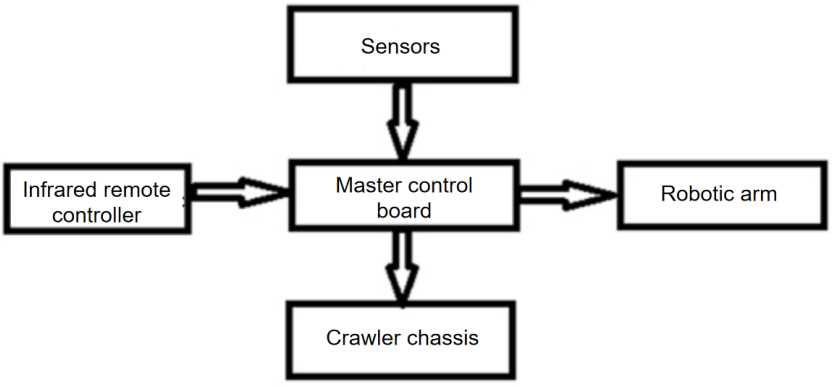

Figure 2. System block diagram of picking robot[4]

Figure 3. Picking Robot[5]

2.2. Application of intelligent robot in crop spraying

Japan's intelligent robot technology in crop spraying is relatively advanced, which is inspired by the automobile industry, using instruments, pressure devices and automatic spraying devices. The basic principle is that the walking path of the robot is controlled by the cable, and there is current in the cable, and the current will generate electromagnetic field when it flows through the cable. The control device of the spraying robot can control the walking direction of the robot after receiving the electromagnetic information sent by the cable, and the automatic spraying controller is responsible for the specific spraying operation.

The intelligent spraying robot can spray drugs on all kinds of trees and crops, and can also intelligently judge the walking direction, such as turning or turning. This robot also includes contact sensor and ultrasonic sensor control system, which is mainly used to detect the surrounding environment. Once the drug spraying system encounters an obstacle, the sensor will automatically send out an alarm message and implement response protection measures for itself. The robot has two operation modes, automatic and manual. At both sides of the robot, there are manual buttons for manual operation to switch the robot to manual mode.

Figure 4. Spray robot[6]

2.3. Application of intelligent robot in crop grafting

Grafting robot is an intelligent robot developed by TGR Grafting Technology Research Institute in Japan, which is specially used for grafting all kinds of crops. Grafting has three main processes: cutting, connecting and selecting. Among them, the grafting robot is mainly a fully automatic mode, which can automatically detect suitable grafted seedlings and defective seedlings and skip these defective seedlings. The grafting success rate of this grafting robot is 98%, and the level is high. The vegetable grafting robot developed by researchers in China is mainly controlled by computer, which can better promote the grafting of cuttings, seedlings and seedlings.[7]

Figure 5. Grafting robot [7]

2.4. Application of intelligent robot in weeding

The application of intelligent robots in weeding can greatly reduce the use of herbicides, thus protecting the healthy growth of plants. Its principle is mainly to use radar device and unmanned electronic equipment to reach the area that needs weeding, and its sensor will receive the signal from the position of weeds, and its mechanical spray can be turned on immediately, thus achieving the effect of effective weeding and accurate weeding, and protecting the ecological environment to a certain extent.

Figure 6. Weeding robot[8]

3. Key technologies of agricultural intelligent robots

The sharp increase in the global population poses a great challenge to the quality and safety of food. In order to meet the world people's requirements for grain yield, price and quality, it is particularly urgent to innovate and improve agricultural technology. Under this background, intelligent robots are one of the best ways to solve this problem. From monitoring the state of soil, analyzing the characteristics of products, harvesting products to mechanical weeding, intelligent robots are making efforts to produce safer products. Using small professional agricultural robots instead of existing harvesters can reduce the compactness of land, thus achieving the purpose of energy saving. The above measures can not only reduce agricultural costs, but also produce safe products more efficiently. Therefore, the application scope of intelligent robots has become more extensive.

3.1. Line Planning and Navigation Technology

If the robot is compared to a "normal person", the first task is to design a brain and eyes for it, because without a brain, the robot can't think, and without eyes, the robot will go astray. Therefore, route planning and navigation are the core technologies of the robot. In practical application, robots need to determine their own working routes, and plan and navigate their own routes and targets. Nowadays, robots can achieve positioning based on centimeter accuracy by using GPS technology. At the same time, the intelligent positioning and orientation perception of the robot can be realized by signal detection and mobile environment positioning technology. Although this technology has more iterations and requires higher computing power of the control system, it has abundant information perception, which can better promote and improve its own working environment.

3.2. Data integration and analysis technology

Robots are exposed to the agricultural working environment, and the data they receive are varied. In the actual working process, the navigation and positioning system and target recognition system of intelligent robots have excellent intelligent attributes, so it is necessary to integrate and analyze the data from subsidy channels, and then analyze the data, the future walking path and walking environment, and pass the analysis results to the execution system, so that the execution system can carry out specific working. Through information integration and fusion, the stability and robustness of the system can be improved, the measuring space and moving space of the robot can be improved, and the super adaptability of the system under difficult conditions can be guaranteed.

3.3. Multidimensional information fusion technology

Through information fusion, the multi-dimensional information comprehensive analysis of the external system can be realized. For example, it can improve the resolution of the system to identify objects, thus improving the reliability of the system and strengthening the stability of the system during operation, so that the intelligent robot will not have fault problems during work. At the same time, there should be information fusion technology and information enhancement technology inside the robot, and certain rules should be adopted to strengthen the information obtained from the outside, so as to improve the motion accuracy and work efficiency of the robot.

4. Conclusion

To sum up, in order to meet the global requirements of high yield, low price and high quality of grain, it is more urgent to improve and innovate agricultural technology, and intelligent agricultural robots are one of the technologies to solve these problems. From monitoring soil conditions, plant characteristics, specific harvesting to mechanical weeding (in order to avoid spraying pesticides and herbicides) to produce more safe food. Using successful small professional agricultural robots to replace the current harvester can reduce the compactness of the land and achieve the purpose of saving energy. These can not only save costs for agricultural production, but also produce safer food and

improve production efficiency. In the field of agricultural automation, intelligent robots can not only make agricultural production efficiency higher, but also greatly reduce the cost of agricultural production. With the continuous maturity of related technologies, the application scope of intelligent robots will become wider.

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