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Design and implementation of Intelligent transplanting system based on photoelectric sensor and PLC*

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Abstract: Industrial seedling rearing is an important part of seedling transplanting technique. At present, there exists the phenomenon that soil base on the tray may have empty seedling on it, which will lead to a large number of leakage and reduce the yield in the course of automatic transplanting in the field. To solve this problem, automatic seedling identification method is studied to skip picking empty soil bases. An intelligent transplanting system are designed with the use of the picking mechanism five-bar and fixed-axis gear train, the seedling tray conveying mechanism (with transverse and longitudinal seedlings feeding function), the eccentric disc parallel four-bar duck mouthpiece planting mechanism, the electric sensor for seedling detection and identification of the seedling tray, the position sensor, stepper motor and PLC control system. By use of computer logic programming and control, it can be used to identify effectively whether the soil base is empty or not, and to control the automatic transmission of seedling tray. The tray is moved to quickly skip the action path of the manipulator to avoid the picking of empty soil base. The system was tested by using pepper seedlings on indoor condition. The results showed that when the transplanting frequency was 90 / min, the rate of success seedling picking was 88.23% and the leakage rate was 16.46%, which could meet the requirement of pepper transplanting. Compared with the transplanting model without seedling identification, the average rate of leakage was reduced about 12%. The research provides a useful reference for the development of intelligent agricultural transplanting technology and equipment.

Keywords: Intelligent agricultural; Transplanting system; Automatic recognition; PLC control; Logic programming

1 Introduction

The vacancy of seedling in factory seedling cultivation is an important factor leading to the leakage of subsequent mechanical transplanting. In the whole automatic transplanting process, the number of seedlings planted in the unit area will be reduced if the vacancy of seedling cannot be effectively identified and avoided which will reduce the production. At present, the main way to deal with this problem is to fill the seedlings after planting. The whole process is characterized by high labor intensity, low efficiency and high cost [1-3]. Therefore, it is urgent to improve the intelligent level of mechanical transplanting technology. The advanced sensor and computer logic control technology are applied to the transplanting equipment to realize the independent identification and selective operation of the machine.

Many useful researches have been done in the field of seedling identification and intelligent transplanting. For example, Tai et al. [4] used machine vision for automatic seedling raising in greenhouse, a recognition system is developed, which can automatically identify the empty pot on the seedling tray. Ryu et al. [5] designed an automatic transplanter system including machine vision, which can realize the functions of automatic conveying, grabbing and planting seedling. Humphries S et al. [6] used the image tracking algorithm to divide the seedling plants into different parts with similar geometric characteristics, and realize the classification and recognition of the leaves, stems and main

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