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Application of Image Recognition Technology in Target Recognition of Automated Apple Picking Robot

Ya Wang[1,*]
[1]Puyang Vocational and Technical College, Puyang, Henan, China, 457000

Article Info
Volume 83
Page Number: 5313 - 5318
Publication Issue:
July - August 2020

Article History
Article Received: *25 April 2020*
Revised: *29 May 2020*
Accepted: *20 June 2020*
Publication: *28 August 2020*

Abstract

Scientific and reasonable flower and fruit management of apple trees is conducive to ensuring the health of fruit trees, so as to achieve high quality and high yield of apples. Different varieties of apples have different fruit types and different fruit setting rates. Therefore, the picking robot needs to install a flexible end effector to ensure the integrity of the picking fruit. Different fruits will grow in different locations. For example, some fruits grow on trees and some fruits grow on vines. In addition, there are differences in the size and maturity of the fruit, so the robot's visual positioning is more difficult. When designing a picking manipulator, the cultivation methods of fruits and vegetables should be considered to ensure that the manipulator can meet the picking requirements, and will not damage the stems, leaves and other parts of the plant, and can accurately grasp the fruits according to the set route. Therefore, manipulators need to have the ability to avoid obstacles, and redundant manipulators can be used. This kind of mechanical means has obvious advantages, but because of the higher degree of freedom, the control is more difficult. Picking robots are mainly operated by farmers, so the operation of the robots should not be too difficult to ensure that farmers can quickly learn and master. In addition, the production cost of robots must be controlled to ensure that farmers can afford the cost of purchasing robots.

Keywords: *Automation, Picking, Robot;*

1. Introduction

In order to solve the problem of slow manual picking speed and low efficiency, based on the research of mechanical transmission, a transmission module of the apple picking system was designed. In the application process of electromechanical automation technology, it can realize the automatic supervision, alarm, diagnosis and maintenance of the production process, ensure the safety of equipment operation, reduce the occurrence of accidents in the production process, and reduce the generation of losses. In addition, in the manufacturing of construction machinery, most of the original equipment is composed of electronic components, which can effectively reduce the wear efficiency generated when the material is running, enhance the sensitivity and stability of the components, and extend the service life of the equipment.The application of electromechanical automation technology can effectively reduce manpower consumption. The application of electromechanical automation technology only needs to set the equipment before production to complete the entire production operation and control process, which greatly reduces the use of manpower, saves more costs, and accelerates work efficiency and improves

Published by: The Mattingley Publishing Co., Inc.

TEST Engineering & Management

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production quality. , But also create more profits for the enterprise. The application of electromechanical automation in construction machinery manufacturing. Mechanical automation is a comprehensive technology type, which contains relatively many automation technologies. There are three core technologies, flexible automation technology, integrated automation technology and intelligent automation technology. These three technologies play an important role in different construction machinery manufacturing links and have significant effects on improving the level of construction machinery manufacturing. Below we will separately describe the application of these three automation technologies.

2. Apple picking machinery

The transmission module is composed of four parts: a 360overall rotation device, a vertical expansion device, a folding device and a horizontal expansion device. The 360overall rotation device is composed of a stepper motor, a worm gear and a worm. Driven by the stepper motor, the worm and worm gear are driven to rotate to achieve overall free rotation; the vertical telescopic device is composed of a 9 V encoding motor, a gear box and a rack. The 9 V encoding motor drives the gear box, which is transmitted to the pinion gear meshing with the rack to realize the vertical expansion and contraction of the vertical expansion device; the folding device is composed of 9 V encoding motor, gear box, rack, air pump motor, air pump and air pump valve. The gear box is driven by a 9 V encoding motor and the gear box and rack work together with the air pump to achieve folding and unfolding; the horizontal telescopic device is composed of a 9 V encoding motor, gear box and rack and the gear box is driven by a 9 V encoding motor , It is transmitted to the pinion gear meshed with the rack to realize the telescopic movement of the transverse telescopic device. The working principle of the transmission module, the stepping motor of the 360° integral rotating device is connected to the worm and the worm gear is fixed on the bottom horizontal plate, the vertical telescopic device and the integral bracket are hinged together and the rotating bracket and the top of the integral bracket are connected together. The left end of the rotating bracket is hinged with the vertical telescopic device and the folding device connects the right end of the movable bracket with the telescopic device. After determining the picking target, the transmission module enters the working state: the motor of the folding device rotates forward, the air pump valve opens and the air pump pushes the gas into the rodless cavity of the pneumatic cylinder. Under the action of the gas pressure, the push rod is pushed out and the push rod is pushed out. It moves upward in a straight line and the horizontal arm of the horizontal telescopic device rotates counterclockwise with the hinge as the axis of rotation and rises to the same straight line as the rotating bracket and the folding device is unfolded[1]. The picking robot system is in the figure below.

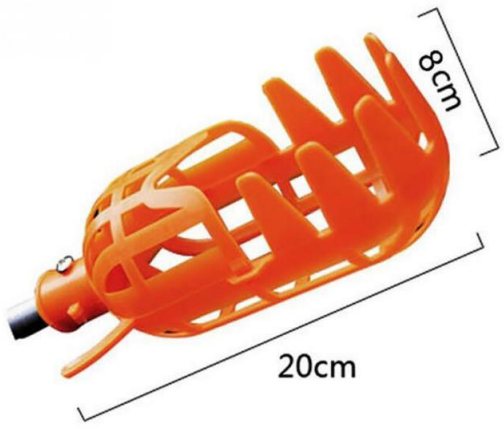

Figure1. Picking robot system.

The 360° integral rotating device is driven by a motor, which drives the worm wheel and its whole to rotate around the Z-axis through a worm and turns to the same direction as the picking target. The motor of the vertical telescopic device rotates forward and the hinge drives the left end of the rotating bracket to move downward, the rotating bracket rotates counterclockwise around the center of rotation and the right side of the rotating bracket and the horizontal bar of the horizontal telescopic

Published by: The Mattingley Publishing Co., Inc.

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device move upward through the lever to reach the height of the picking target; The motor of the transverse telescopic device rotates forward and drives the picking module to move in translation on the cross bar to reach the apple stem. The transmission module can improve the picking range and workefficiency[2]. The picking robot electrical system is in the figure below.

Figure2. Picking robot electrical system.

3. Application of automated picking technology

3.1. Semi-mechanized apple picking machine

The semi-mechanized picking machine was jointly developed by the National Apple Engineering Technology Research Center of my country and Ningxia Wuzhong Lvyuan Technology Co., Ltd. The manual hand-held vibrating apple picking machine broke the history of conventional manual labor and also played a very important role in changing people's ideas. Great effect. The apple picking machine mainly uses the principle of vibration to put the branches of apples into the branch grasping machine and the eccentric wheel is driven by the motor to rotate and the fruit is separated under the action of gravity. The picking rate of the apple picking machine is relatively high and the apple The damage rate is relatively low, which can save labor costs and increase farmers' economic income. Of course, due to the immature technology of the apple picker, there are many shortcomings during the actual operation. First, during the operation of the apple picker, due to the effect of vibration, the picker’ s wrist is fatigued, so the time for insisting on the operation is relatively long. Short; secondly, due to the effect of vibration, it is easy to cause the loss of apple fruit during the shaking of the branches and if the length of the apple branches is different, the phenomenon of incomplete fruit picking is likely to occur[3]. The picking robot processing system is in the figure below.

Figure3. Picking robot processing system.

3.2. Large self-propelled apple picker

With the advent of apple picking machines, more and more apple picking machines are being promoted in the market. Jingqi 4SLZ-2200B self-propelled apple picking machine is mainly composed of power part, transmission part, shaking device, fruit leaf The separation device and the collection part are composed of a grid of multi-point uniform distribution, high-frequency vibration and shaking principle. Distribute the high-frequency vibrating rods evenly at multiple points and evenly distribute the vibrating rods around the apple branches. The vibrating vibrating rod makes the apple fruit fall into the sealed receiving device under the action of appropriate force and then pass through the leaf separation mechanism. The leaves and fresh fruits are separated and the fresh fruits are transported to the collection box via a special belt. Through the three-generation picker picking experiment and improvement, it is possible to complete apple shaking, fruit leaf separation,

Published by: The Mattingley Publishing Co., Inc.

July - August 2020
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collection and transportation at one time and further increase the intelligent operating system, avoid repeated operations, reduce the labor intensity of the operators and improve[4]. The picking robot system is in the figure below.

Figure4. Picking robot system.

4. Automated machinery optimization analysis

4.1. Overall design

Three sections of stainless steel telescopic rods with dimensions of 90cm, 70cm and 80cm are used to realize the expansion and contraction of the hand-held rod. Fiber friction materials or rubber materials are added to the joints to realize the expansion and contraction of any length. The diameter of the hand end is reduced by 3cm and a detachable section is reserved to prevent the whole from being too short or too long and it is convenient to reach the fruit picking at too high or low points. The suction cup manipulator is used to absorb fruits under negative pressure and the size of the middle hole can be changed to pick different kinds of fruits. The outermost layer of the suction cup manipulator is made of iron sheet or 3D printed funnel-shaped shelf, the middle layer is the foam layer and the inner layer is the rubber layer wrapping layer and the innermost layer is the mesh cloth wrapped sponge layer and intimate contact with the fruit to ensure that the fruit is not damaged. We found that the test is zero damage. The air pressure is set according to the use environment and air pressure barrels of different sizes are used. Each side has an air hole of about Φ2cm to connect to other devices. Taking into account the economic and safety issues and conducting actual tests, it is found that it is unnecessary in the actual operation process. The low-pressure barrel is pumped to a complete vacuum state and the pressure of the high-pressure barrel will not be too high, so the wall thickness can be appropriately reduced. The thickness is designed to be about 2.5mm. The material is white steel 201, which saves costs and is safe and reliable[5]. (1) The combined use of gasoline engine and vacuum pump not only solves the power supply problem but also provides convenience.(2) The use of vacuum exhaust reduces the damage to the fruit and facilitates picking.(3) The combined design of the shrink rod and the suction pipe simplifies the appearance and meets the needs of use.(4) The clever design of the switch, flexibly realizes the grasp and release of fruits. The picking robot truck is in the figure below.

Figure5. Picking robot truck.

4.2. Design advantages

This design starts from low cost, practicality, wide applicability, simple structure, easy control and operation, reduces labor intensity and production costs of workers, improves labor productivity and product quality and breaks the previous concept of

Published by: The Mattingley Publishing Co., Inc.

TEST Engineering & Management

July - August 2020
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robot research in the direction of high depth. The design of a small auxiliary manual fruit picking machine. In addition, it also solves the shortcomings of traditional manual work. That is, the first is the personal safety of the workers during the picking process (the arms are easily scratched or scratched by the branches during manual picking and they may fall when working at high places); the second is to ensure the fruit The quality avoids problems such as peeling of pedicles and core fruit when picking with one hand and high-branch fruits that are easy to fall on the ground, causing internal and external injuries, affecting the appearance of the fruit, not conducive to fresh storage and ultimately reducing economic income. In addition, this design uses a combination of a gasoline engine and a vacuum pump and the gasoline engine directly supplies energy, avoiding the inconvenience of plugging in and solving the limitation of being far away from the power source in the actual fruit picking process. This design product has a wider application range and can provide electricity for a long time even in remote mountain orchards to ensure the normal operation of the vacuum pump. Compared with soil diagnosis methods, leaf diagnosis can more comprehensively and objectively reflect the nutritional status of plants. There is a big difference between the leaf diagnosis results of normally planted trees and abnormally planted trees. Therefore, leaf diagnosis can reflect the actual nutritional requirements of fruit trees more truthfully and accurately. After determining the nutritional requirements of the fruit tree, the gardener can formulate a fertilization plan according to the actual growth requirements of the fruit tree and then fertilize the fruit tree at a reasonable time to ensure the better growth of the fruit tree.The growth of fruit trees has special requirements for the nutrient content of the soil. Only by ensuring that the nutrients in the soil can meet the nutrient requirements of the growth of the fruit trees can the fruit trees grow really long. The specific procedure for testing and diagnosing planting soil is to collect fruit tree planting soil and use advanced laboratory equipment to diagnose, analyze and research various nutrient costs in the soil. By diagnosing the nutrient content in the soil, analyzing the actual nutritional status of the fruit tree and determining the planting area, fertilization amount and method of the fruit tree based on the analysis result. For a long time, the determination and analysis of the soil composition of fruit trees is an effective method for diagnosing the nutrient status of fruit trees, which can guide the application of horticultural picking techniques[6]. The picking robot management system is in the figure below.

Figure6. Picking robot management system.

5. Conclusion

At present, mechanical fruit picking devices are widely used, but the development of the device is not mature enough and there is still more room for improvement. Its development has the following trends: (1) Multifunctionalization. The fruit picking, collection, packaging and transportation are combined in one stop. (2) Portability, simple operation, good reliability and high safety. (3) Good versatility. Aiming at different geographical

Published by: The Mattingley Publishing Co., Inc.

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environments (flat land, sloping land, etc.) and different varieties of similar fruits (such as apples, pears, peaches, etc.), this device should be suitable for most. (4) Automation and intelligence. Pay attention to the automation and intelligent research and development of fruit picking devices, improve picking efficiency, reduce picking costs, reduce human labor and liberate labor.

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