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Research on a Loquat Picking Equipment

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Abstract. Dongting loquats are often cultivated on the slopes of Wushan. The height of the loquat trees is more than ten meters, which brings great inconvenience to the harvesting work. The fresh fruit period is short, and it is not durable for storage and transportation. The high market price, the rapid price changes, and slow manual picking have seriously affected farmers' income. This paper elaborates the recent status of fruit and vegetable harvesting at home and abroad. A simple picking device that does not damage the fruit is designed aiming at the pure artificial harvesting of loquat at present. Based on the analysis of the working principle, the prototype is made and tested. The experiment results show that the loquat harvester is easy to operate, simple in structure and low in price, and can be harvested at different heights and sizes, which greatly relieves the labor intensity of workers.

1. Introduction

Loquat is an evergreen small tree that likes to grow in a warm and humid place, and it is suitable to grow in the shade.

Loquat planting is widely distributed, but as economic cultivation, it is limited to Dongting east and West mountain in Suzhou, as well as Guangfu, Nantong, Haimen, Yangzhou and other places. Dongting east and West mountain account for more than 90% of the province's output, which is one of the famous loquat producing areas in China, and also one of the most evolved loquat varieties in China. At present, the existing loquat planting area in Dongting mountain area is more than 4,000 acres, with an annual output of more than 1,000 tons, which is the primary planting variety and economic income source of local farmers. Therefore, research on loquat picking equipment can not only reduce labor intensity and improve labor productivity, but also have broad market application prospects.

2. Research status of fruit and vegetable picking equipment

According to the survey, American scholars, Schertz and Brown, first proposed the idea of using robots to pick fruits and vegetables in 1968. At present, the Netherlands, Japan, Italy, France, the United States, the United Kingdom and other countries have launched various research work on fruit and vegetable picking robot. The research objects involved mainly include apples, oranges, tomatoes, cucumbers and grapes. In China, the research on agricultural picking robot started later than that of developed countries in the 1990s. However, many universities and research institutes in China have conducted research in the fields related to picking robot and intelligent agricultural machinery at present. For instance, Shanghai Jiao Tong university is carrying out a research into the cucumber picking robot, Zhejiang university performed kinematic analysis and research on tomato harvesting



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manipulator, Nanjing agricultural university analyzed and studied the obstacle avoidance path planning of eggplant harvesting robot and robotic arm, and Jiangsu university and Zhejiang university studied the tomato harvesting manipulator. It can be said that at present, many domestic universities and research institutes have taken fruit and vegetable picking equipment and service for agriculture as an important topic to study, but according to the investigation, there is no research on loquat picking equipment in China.

3. Design of lightweight loquat picker

3.1. Requirement analysis of the picker

Based on the experience provided by pickers and combined with the growth characteristics and environment of loquat, the design requirements of loquat picker are as follows:

The picker is simple in structure, light in quality, labor-saving in operation and low in manufacturing cost.

The picker must have sufficient strength and stiffness to avoid breaking or deformation.

The picker can not only pick the loquat, but also collect the loquat in the bag to reduce waste as much as possible.

In order to meet the requirements of picking loquat at different heights, the picker should be designed with retractable structure to meet the requirements of different plant heights.

3.2. The general structure and working principle of the picker

Based on the above design requirements, a preliminary scheme design is carried out for the picker. There are mainly two schemes: scheme 1 is a circular saw picker, as shown in Figure 1. Scheme 2 is a reciprocating cutter picker, as shown in Figure 2.

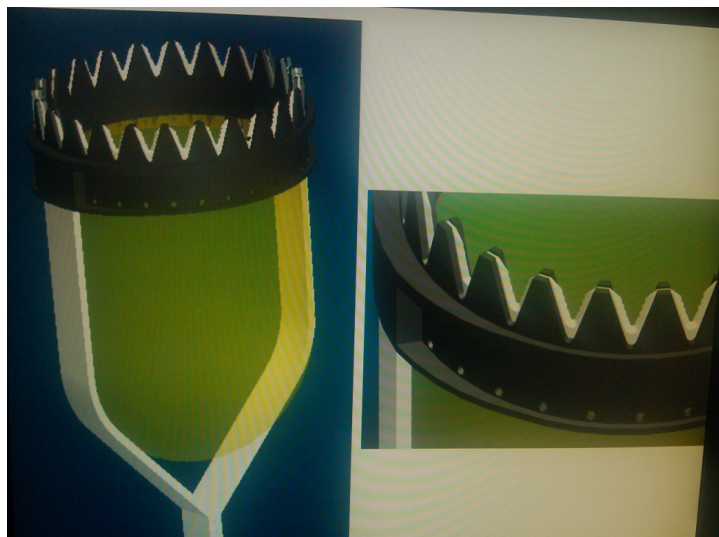


Figure 1: Circular saw structure picker

Through comparison and analysis of the two designs, it is found that although the structure of the scheme 1 is simple, there are some problems in the grasping and cutting of loquat roots, and it is not easy to harvest loquat in the actual operation. Finally, the design of scheme 2 is adopted. As shown in Figure 2, reciprocating loquat picker is mainly composed of power head assembly, collection bag, long handle, length regulator, handle and control assembly. The structural principle of the power head component is shown in Figure 3, which is mainly composed of gear box (big gear, tower pinion), dc motor, blade, etc. Loquat plucking machine cutting institutions chosen as shown in Figure 3 at the end of the reciprocating cutter type (the principle is similar to the scissors), in the loquat plucking, the

operator needs to press a button on the handle gently only, can make dc motor start and drive the movement of the size of the gear in the gear box, eventually lead the complete cutting blade loquat fruit stem, and loquat can fall into the collection bag (shown in Figure 2 rings collecting bag for installation), so as to complete the entire process of picking. In the design, the length of the handle of the loquat picker is designed as an adjustable length structure (the length regulator shown in Figure 2 can be used to freely adjust the length of the handle according to the plant height). After using the picker, the trouble caused by moving ladders and other height climbers can be avoided, which is convenient and safe.

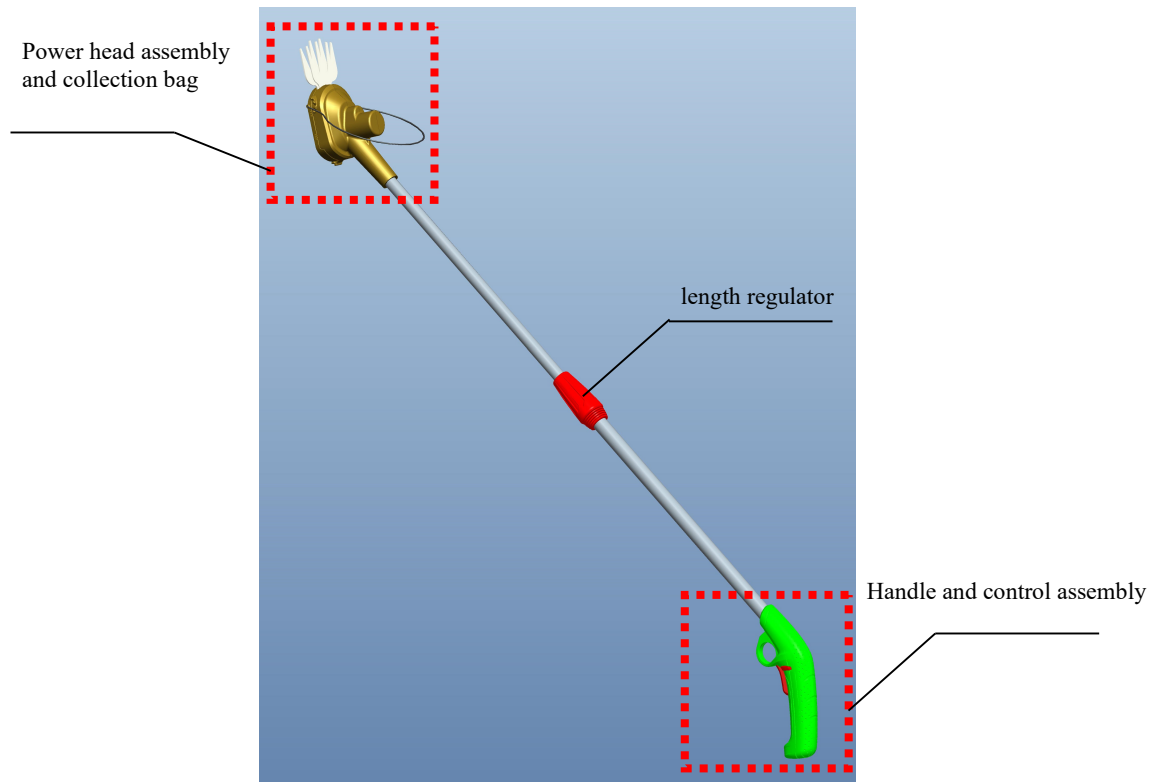


Figure 2: Reciprocating cutter picker

4. Prototype production and test verification

Figure 4 shows the finished prototype. Through in-depth ecological loquat industrial park of Dongting mountain in Suzhou to field test (test images as shown in Figure 5), the operator feels the picking device has simple structure, convenient operation. Just press the action button on the handle component can complete the action of cutting loquat fruit stem, and loquat that fall into the collection bag, complete the whole process of picking. The picking of loquat at different heights can be achieved by adjusting the length of the components during the picking process.

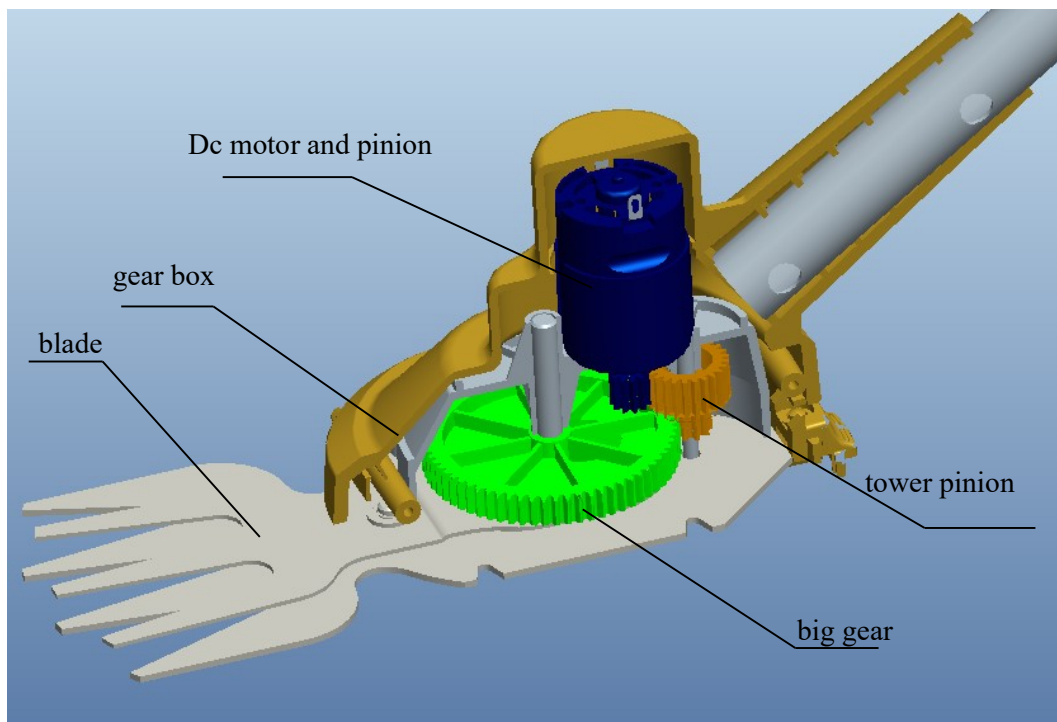


Figure 3: Picker power head structure schematic diagram



Figure 4: A prototype of the loquat picker



Figure 5: The test of the picker

5. Conclusion

The designed picker can pick loquat and meet the design requirements. In the future equipment debugging and improvement, we should try our best to coordinate the functions of each part. If the automatic machine can be used for picking, the operator can be further liberated from the heavy labor, making it more labor-saving, timesaving and better serve the fruit farmers.

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