The Design and Research of A Hand-Held Stepless Retractable Fruit Picker Based on Single-Chip Computer

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Abstract

Picking fruit is a strong manual labor. Considering the high labor cost and the principle of efficiency, it is necessary to develop the fruit picking machine which combine the fruit picking and fruit weighing together. In this design of this paper, the hand-held stepless retractable fruit picker can carry out the extension of the rod length under the control of single chip microcomputer, which can complete the weighing while picking fruit without any damage fruit, improve the efficiency and protect the fruit integrity. After repeated measurement and verification, the system is not only convenient to pick, but also has high weighing accuracy, wide weighing range, stable and reliable operation and convenient to carry. It can reduce labor cost and work intensity for fruit picking, and this design has the promotion value.

Keywords

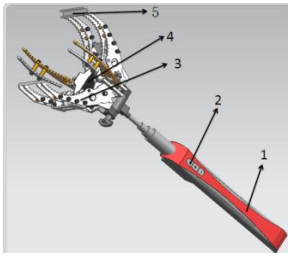
Fruit picking; Singlechip; Stepless retractable rod; Pressure sensor.

1. Introduction

China is the world's largest fruit producer and the world's largest fruit consumer. In 2008, China's total fruit output exceeded 60 million tons, accounting for about 14% of the global output. The rapid development of fruit planting has increased the market demand of orchard machinery. Currently, there is no fruit picker with weighing function on the market. If it is picked manually and weighed step by step, it is not only inefficient and labor intensive, but also easy to cause fruit damage. Therefore, it is of great significance to develop a fruit picker with weighing function.

2. Hardware Design of Fruit Picker

The hardware of the fruit picker is composed of mechanical claw, electronic scale, expansion bar, button and two servo motors and single chip microcomputer installed in the bar handle. The overall structure is shown in Figure 1:



1. Automatic expansion rod; 2. Operation button; 3. Display screen; 4. Electronic scale; 5. Pick claw

Fig 1. Structure diagram of fruit picker

In figure 1, the length of the telescopic rod 1 can be stepless adjusted by a small servo motor during the picking operation to facilitate the picking. 3 is an electronic display that shows the pressure of the claws and the weight of the fruit. 4 is the picking claw controlled by single chip microcomputer. 2 is the button. There are three buttons in the picker. The three buttons can control the servo motor forward turn, reverse and stop. When the servo motor forward turn, the rod can expand continuously. When the servo motor is reversed, the control rod can be shortened continuously. When the servo motor stop , can maintain a certain length of the rod. The button in different position can also controls another servo to control the opening and closing of the picking claws. Under the control of sensor and microcontroller, the force of the claw can be closed to grab the fruit in the proper range, so as not to damage the fruit.

Figure 2 is the structure diagram of the picking claws. The mechanical claw controlled by the steering gear through the singlechip to make the claw move. The steering gear is a position servo driver, which can realize the grabbing and release of fruit by stretching about 0-180 degrees.

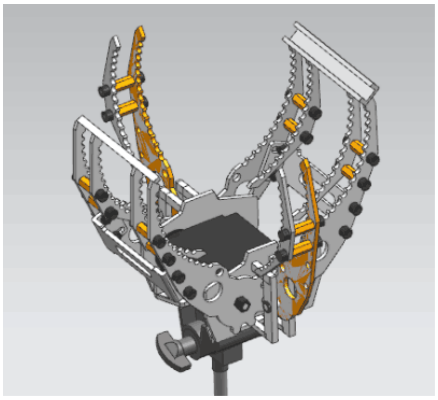


Fig 2. Picking claws of fruit picker

The control signal of the steering gear is the pulse width modulation (PWM) signal with a period of 20ms, in which the pulse width is from 0.5ms-2.5ms, and the position of the corresponding steering wheel is 0-180 degrees, showing a linear change. That is, by giving it a certain pulse width, its output axis will remain at a corresponding angle, no matter how the external torque changes. The servo has a reference circuit inside the servo, which produces the reference signal with a period of 20ms and adjustable width. The circuit has a comparator, which compares the external signal with the reference signal to determine the direction and size, thus generating the motor rotation signal.

3. Fruit Picking Circuit Design

3.1 Crystal Circuit Design

STC89C52 has a high-gain inverting amplifier that makes up the internal oscillator. The crystal oscillator circuit is composed of crystal oscillator Y1 and capacitors C4 and C5, and the single-chip computer U2 pin 18 (XTAL2) and pin 19 (XTAL1) are used to connect the crystal oscillator . In order to calculate the clock cycle of a single-chip computer, the ceramic passive oscillator vibrator of 11.0592MHZ was selected as the crystal oscillator Y1 in this paper. C4 and C5 are auxiliary crystal vibrating capacitors, which are generally porcelain chip capacitors. C4 and C5 can use only one or two in the circuit at the same time. This design selects 30PF capacitance.

3.2 Reset Circuit Design

Reset circuit is an indispensable part of the operation of the single chip microcomputer. The reset function of the single chip microcomputer is equivalent to the restart function of the computer. When the single chip microcomputer crashes or the program runs into the dead loop during operation, the reset circuit of the single chip microcomputer is needed to help the single chip restart or jump out of the

dead loop. The reset circuit of MCU mainly has two reset modes: key switch reset and power on reset. In this paper, the reset mode is adopted to power on reset..

3.3 Strain Resistance Chip Design

The picker takes the single-chip computer as the control chip, adopts the resistance strain pressure sensor to collect the pressure signal, converts the pressure signal of the claw to the corresponding electrical signal through the pressure sensor, and after the ADC0832 amplification processing, displays the pressure data on the LCD screen, so as to set the appropriate pressure. The chip is an eight-bit resolution, two-channel AD conversion chip. It has small size, compatibility, cost-effective characteristics. The resolution can reach 256 levels, which can meet the design requirements.

3.4 Weight Conversion Circuit Design

Fruit weighing is realized by HX711AD module. The circuit diagram of this part is shown in figure 3.

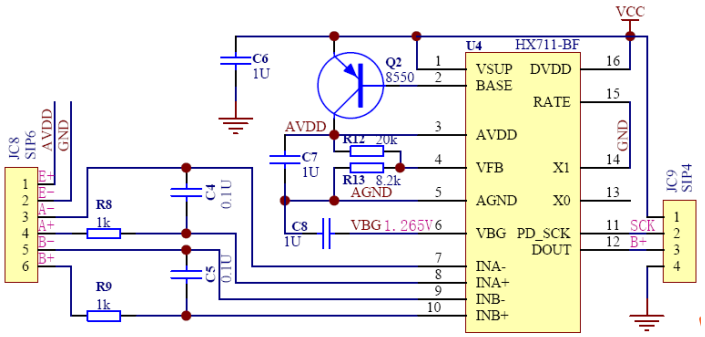


Figure 3. Circuit diagram of HX711AD conversion module

As shown in figure 3, U4 is the HX711 chip, 16 pin connected to the power supply VCC, 14 pin connected to the common ground end, 2 pin is the output control end of the external stabilized voltage power supply, and AVDD is the output of the external stabilized voltage power supply, which is used to provide the excitation stabilized voltage power supply to the strain resistance sensor. The stable voltage output value of AVDD is determined by the resistances R12 and R13. The physical picture of HX711AD module is shown in figure 4.

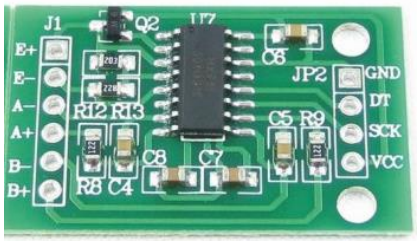


Figure 4. Picture of HX711AD conversion module

4. Working Environment Requirements for Fruit Picker

4.1 Working Voltage and Power Consumption

Power consumption is an important parameter for electronic products. According to the power consumption of major active components, the minimum power consumption of the system needs to meet the requirement of 500MA. Therefore, DC5V-1A power supply is finally adopted in this paper to power the system to ensure the system's requirements on working voltage and power consumption.

4.2 Working Environment Requirements

Considering the influence of temperature fluctuation caused by temperature change, the system recommends the best temperature is 0 to 45 degrees Celsius. The working humidity environment is 10%-80%RH.

5. Conclusion

The traditional fruit picker can only achieve the single picking, but the design in this paper is to quickly weigh the fruit while grabbing it, which can well protect the fruit from damage and quickly obtain the fruit weight, thus improving the efficiency of picking and weighing.

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