Design of Auxiliary Feeding Device Based on Single Chip Microcomputer Control System

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Abstract. People's daily life activities, such as eating, washing and dressing, are very important to the quality of life. However, for many people with disabilities, including those with upper limbs, these tasks prove to be challenging without the help of human caregivers. However, the shortage of medical workers and rising medical costs have created an urgent need for innovation, making aid more affordable and effective. A typical auxiliary task is dietary assistance, which is the basic daily necessities for maintaining health. People with upper limbs and limbs often have difficulty supporting themselves. Technical intervention can solve the problem by bridging the gap between physical ability and necessary functional ability. This design is based on a single-chip microcomputer control system-assisted feeding manipulator design, which can assist in completing the feeding function, and can also add voice or facial recognition modules to enhance the human-computer interaction experience. The design is mainly composed of editing controller-control and detection-power element. That is, the food is fed through a control program, transmitted to a target position through a power element, and whether feeding is completed is judged through a control and detection device. And we will try to add some functional modules to enhance the human-computer interaction experience.

1 Introduction

In 1954, American scientist Wall (also known as the "father of robots") obtained a patent for the first manipulator device. This device has a new memory device that can control from one point to another. movement. In 1970, Victor who is one of the early innovators in robotics, showed a computer-controlled manipulator called the Stanford manipulator at Stanford University. The manipulator is a cross-integrated system integrating mechanics, electronics, control, computer, information and other disciplines. Modern control theory has further improved the performance of the robot control system. Network communication technology enables multiple manipulators to coordinate their actions, which also enables them to transition from dedicated equipment to standard equipment. The rapid development of microelectronic technology and the use of large-scale integrated circuits have greatly improved the reliability of manipulators[1-2].

In the future development process, the main direction of the manipulator is roughly as follows: the mechanical structure moves in the direction of modularization and reconfiguration. The manipulator control system has turned to an open PC-based controller suitable for standardization and networking.[3-4] In addition to traditional sensors such as speed, speed and acceleration, assembly and welding manipulators also use sensors such as vision and power, while remote control manipulators use many sensors synthesis technologies such as vision, sound, power, and sensation for environmental modeling and decision control.[5-6]

It is designed as an auxiliary feeding manipulator, so it is necessary to realize automatic control and automatic detection in some positions. Electronically controlled hydraulic lever and sensor are used, both of which can realize automatic control and automatic detection. Because the structure of the design is relatively compact, it is a small mechanical device. In addition, considering the economic cost issue, a smaller and lower economic cost structure is designed in a comprehensive manner sensor.

2 Scheme and structural design

2.1 Main structure

The device is mainly divided into five parts. The first part is the fixtures. The main function of this part is the opening and closing of the fixed system and the system power supply. The device contains the system power supply, and the switch whether the system is fixed or not. The system can only start to run after it is fixed. The second part is the height adjustment device. The main function of this part is to adjust the height of the device. Since different human figures (tables) have different heights, and the device is designed for a better experience. The third part is the main body of the robotic arm. The main function is to be responsible for the steering of the robotic arm and controlling the lifting of the end of the robotic arm. The

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fourth part is the the end of the robotic arm. The main function of this part is to realize automatic detection and automatic control of the device. This part mainly installs sensors to receive feedback from the feeding device to realize detection and control. The last part is the feeding device. The device is responsible for taking out food. And according to the program and the status of the device itself, the information is transmitted to the sensor at the end of the robotic arm.

2.2 System operation process

The flow chart is shown in Figure 1. After fixing the system, first adjust the height to a suitable position, set the starting position and ending position, and record them in the register of the micro controller program. The system starts, the program control manipulator slightly retracts the feeding device, and then moves to the starting position (above the food), then the main body of the manipulator controls the end of the manipulator and the feeding device to move down, and the vertical bottom of the feeding device continues to move down after touching the bottom of the bowl , Until the sensor installed at the top of the vertical position of the feeding device and the end of the robotic arm, the pressure sensor is fed back by force, and the feeding device is controlled to close to complete the feeding. The robot fixes the feeding device to prevent the sensor from being forced to open and close the feeding device and cause the food to fall drop. After the feeding is completed, the robot arm controls the robot arm to move to the end position and puts it in a horizontal state, cancels the fixation, and slightly ejects the robot arm. Under the action of gravity and the principle of leverage, the sensor installed at the end of the robot arm receives pressure from the feeding device. After eating, lift the feeding device slightly, and the sensor at the end of the manipulator is not stressed. Regarding whether the end of the manipulator is stressed as an interruption, the system restarts after completing an interruption to complete the cycle until the entire feeding process is completed.

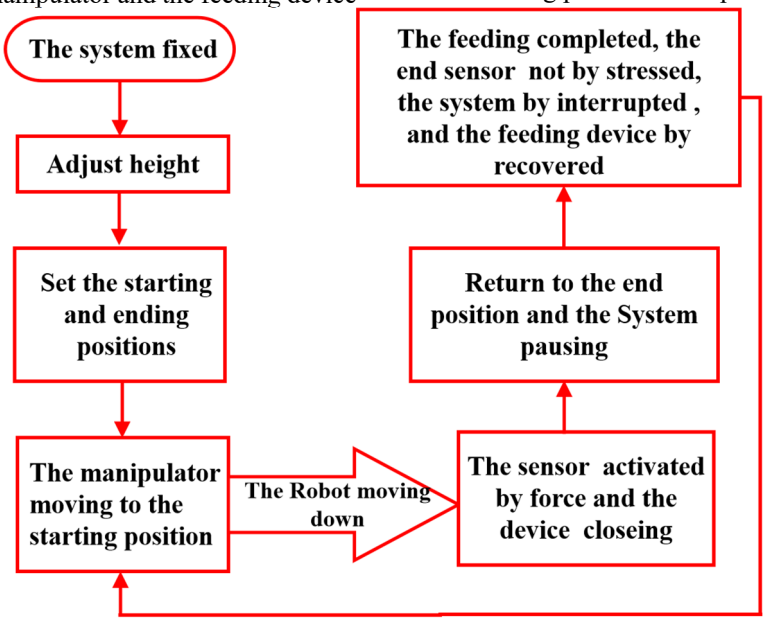

Figure 1. The brief process of system operation

2.3 System main structure design

In order to make the system more stable after start-up, it is necessary to design a device so that the desktop manipulator can be fixed on the desktop, as shown in Figure 2. This part is a sucker-like structure, and the system is placed on the desktop steadily. When the system is started, press the button, the electromagnet will be energized to suck up the top of the sucker. Forming a low-pressure environment in the cavity, the pressure will fix the manipulator.

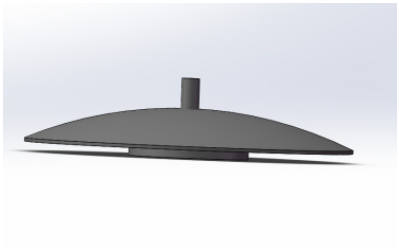

Figure 2. The sucker

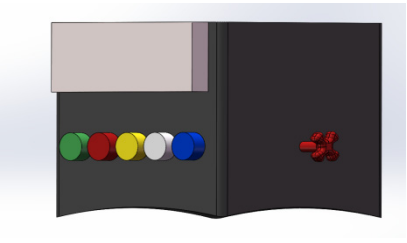

Figure 3. The console

The main function of the workbench is to control the lifting of the desktop manipulator platform, operating the

manipulator program and supplying the power. As shown in Figure 3, The five buttons are in sequence, power (and act as the bottom suction cup fixed by the electromagnet), stop, start, set the initial position (reset), and set the end position. The side knob rotates to control the lifting of the lifting platform. In addition, the display above the button can display the current running status or current time through the program.

The lifting platform adopts a structure similar to an umbrella telescopic pole (as shown in Figure 4), which is more simple and clear. At the same time, a turbine worm structure is installed inside and connected with the knob of the console. So that the rotation of the knob controls the lifting of the lifting platform. The entire mechanical arm mechanism is shown in Figure 5.

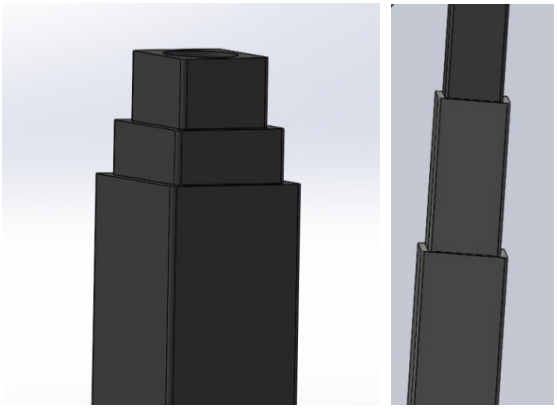

Figure 4. The telescopic rod

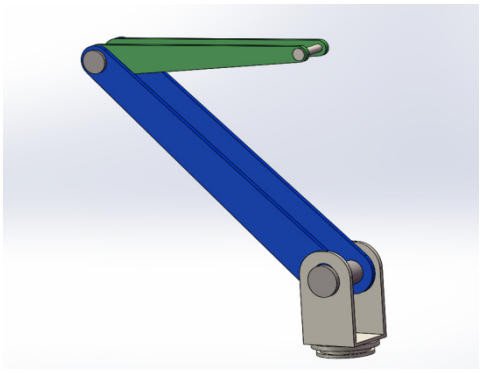

Figure 5. The robotic arm

The blue part in the Figure 5 can be rotated. The opening and closing method is around opening and closing when picking up food. When moving to the designated position, the opening and closing of the rotation becomes to up and down, and only the upper part is opening and closing. This kind of gripper is a fork-like type. (as shown in Figure 6), in addition to feeding liquid and fluid small particles, there are also spoon-like types (combination of spoon and tablet)

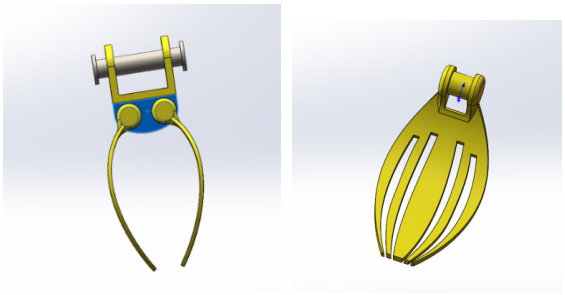

Figure 6. The jaws

The voice module will match the predefined terms according to the input voice terms, and complete the corresponding functional actions. Therefore, the use of LD3320's cyclic recognition mode can meet the requirements of random voice input, and at the same time trigger by password as the trigger source. The general initialization of speech recognition mainly includes soft reset of LD3320, digital signal processor (DSP) sleep low power consumption setting, analog/digital converter initialization and clock rate initialization. The program in the article creates a higher priority speech recognition task in the system, so that the system can make each task run efficiently under the management of the task scheduler. When a voice input produces a recognition result, an interrupt is also generated. Since the design of the desktop assisted feeding manipulator, it is necessary to consider the economy, the use conditions, and the size of the mechanical structure. After comprehensive consideration, the single-chip control system is selected. The single-chip simulation diagram is shown in Figure 7:

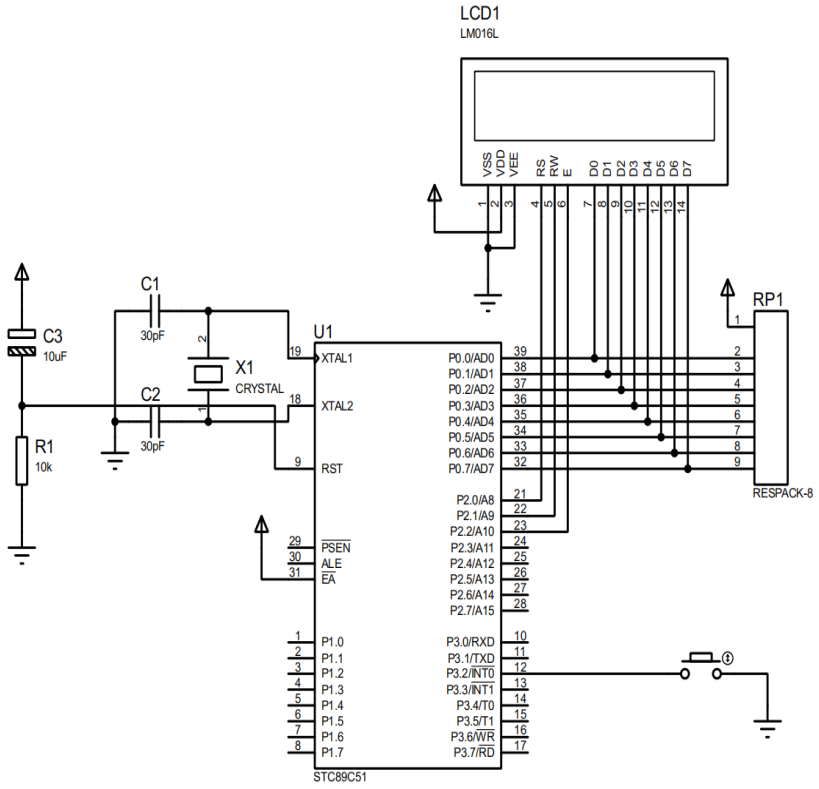

Figure 7. The MCU simulation diagram

3 Conclusion

The mechanical arm part in terms of mechanical claw structure can bear a certain gravity, which is suitable for gripping different forms of food. In the overall structural design, miniaturization and light weight are achieved, which saves materials and improves the economic efficiency of the product. The feedback of sensors is used to realize automatic detection and automatic operation of some structures. The design also has some shortcomings, such as the liquid food falling during the reversal of the gripper. And the tightness of the spoon must also be considered. In addition, the program is relatively rigid, and the position cannot be adjusted independently except directly below the set position. Manual adjustment is required. This shortcoming will be tried to improve in the future design.

Acknowledgements

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