Virtual Laser Electronic Organ

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Abstract. The electronic organ is well known as a musical instrument, but the traditional electronic organ is inconvenient to carry because of its large size, and its use is limited because it is expensive and difficult to popularize widely. Laser piano has incomparable advantages in size and price compared with traditional electronic piano. It represents the research direction of a new type of intelligent keyboard, which can save space, is easy to carry, and realizes lightweight and convenient equipment. Through the change of appearance, we hope that the laser piano can adapt to different scenes and different crowds, not only be fun, easy to get started, suitable for children to learn, but also suitable for the majority of electronic piano enthusiasts.

Keywords: Laser piano, infrared positioning, Camera recognition, k60 Single chip microcomputer.

1. Introduction

Project Content: The player's fingers move within the laser range and play different musical tones. On the premise of fulfilling the performance task, the player will try to improve the performance accuracy, quasi-fluency and enhance the appreciation of music. The main technical proposal: The performance task of the laser piano is divided into two parts: positioning, pronunciation and so on. Positioning: The position of finger is detected by infrared laser module, camera and other sensors (as shown in the figure), and signals are transmitted to K60 single-chip microcomputer for processing and calculation to meet the requirements of positioning. Voice: K60 single-chip microcomputer sends out corresponding audio signals through positioning, controls the speaker through the audio signal conversion module, and sends out corresponding musical tones to meet the voice requirements.

2. Service Conditions

2.1 Existing Work Foundation

This project has a certain theoretical and practical basis. Hardware, electrical and electronic components are available. Digital electronic circuits are relatively easy to implement. Hardware and software systems are available. We hope to improve the performance accuracy, quasi-fluency and enhance the appreciation of music as far as possible on the premise of fulfilling the performance task requirements.

2.2 Overview of Implementation:

It has the foundation of software and hardware, including the principle and application of K60 single chip microcomputer, selection of image sensor and voice chip, and programming. Our research starts with the power supply circuit, first determines the voltage of the power supply module, and selects and builds hardware according to the range value of the voltage. There are mainly two aspects to improve the hardware. One is to use K60 single chip microcomputer to make its performance better and the operation speed is greatly accelerated. The second is the choice of voice chip. The voice chip is selected to work at 3.3V - 5V voltage. After collecting various data, YF 017 series voice chip is finally selected, which is suitable for 2.2V - 6V voltage and has a wide working range. It can work stably with PWM output, 3 IO ports and a 104 capacitor.

After completing the purchase of materials and the construction of hardware, we began to design the appearance. First, we collected relevant electronic organ pictures on the Internet as a reference, and selected a piano model in the piano box mode. After discussion, we made partial changes to the selected figure to adapt to the construction of hardware. After the figure was determined, SolidWorks
was used for three-dimensional solid modeling. The effect of the first modeling was not very good, making us modify the idea of the first two rows of white keys in black keys to become black and white keys on the same level, which is conducive to grating diffraction.

After many discussions, we hammered out a new appearance, then formed the shell with 3D printing and assembled it. The assembly process also encountered many problems, and the hardware was repositioned many times. After the positioning is accurate, the program will be written and the laser piano will be further debugged.

After listening to the teacher's suggestion, we are prepared to further improve the laser piano, make a larger size laser piano, and re-optimize the hardware from the point of view of the voltage of the hardware.

![Fig. 1 Basic principles of positioning](image)

As shown in the figure, the infrared light source is reflected on the CMOS photosensitive device of the camera through the fingertip, the infrared light spot on the CMOS photosensitive device is obtained through binarization processing, transmitted to the control element, and then the finger position is inversely calculated according to the coordinates of the CMOS photosensitive device to achieve accurate positioning.

3. Technical Overview

3.1 Infrared Positioning

The laser module and camera CMOS photoreceptor work together, and the infrared laser module has directivity, monochromaticity and high brightness. The light emitted by the laser is emitted in one direction, and the divergence angle of the light beam is small, close to the ideal parallel light. The spectrum width of the laser is very small, which is several nanometers, so it has a good monochromatic light source. With high brightness and high energy density, under the joint action with camera CMOS photoreceptor, precise positioning can be realized, and the technology of combining laser module with camera to determine the position can be verified, which can be popularized in more technical fields.

3.2 Voice Chip

Voice chip YF 017 series is a chip that can call many kinds of sounds. This chip has the function of output and requires less stable operation. It only needs a 104 capacitor and can emit 32 pieces of sounds. When the chip is working (playing sound), it outputs a low level, and when it stops working or stands by, it keeps a high level. The foot position that receives the control pulse. When a few pulses are received, the contents of the address number are played. This control mode is an analog serial
control mode. If you need to play the contents of the address number, send a few pulses, and you can quickly control any combination of up to 32 addresses.

3.3 Camera Recognition

0V7620 is a CMOS image sensor, which is widely used in products such as webcams and camera phones. The image acquisition system is composed of it. The designed image acquisition system realizes the functions of OV 7620 such as function control, timing synchronization, data acquisition and processing with only one chip. The system structure is compact and practical. This image acquisition system greatly simplifies the system structure, reduces the system design cost and shortens the development period. The acquisition and processing of image data are completed by ARM chips, thus reducing the probability of transmission errors in the data transfer process and improving the reliability of the system.

3.4 3D Printing Appearance

3D printing (3DP) is a kind of rapid prototyping technology, which is based on digital model files and uses bondable materials such as powdered metal or plastic to construct objects by layer-by-layer printing. After modeling by computer modeling software, the built three-dimensional model is "partitioned" into sections, that is, slices, to guide the printer to print layer by layer. The shell is realized by 3D printing technology, which can greatly reduce the cost and has certain popularization.

3.5 Enlargement of Laser Range

The recognition range of the intelligent laser keys has changed from dots to the whole keys, improving the playing precision and enhancing the appreciation of music, so that the laser keys can adapt to different scenes and different crowds, not only have fun and are easy to get started, but also are suitable for children to learn and for the majority of electronic piano lovers.

4. Post-technical Follow-up

We use charging treasure to supply power to single chip microcomputer and stabilize its voltage, instead of using power supply and voltage stabilizing module, thus solving the problem of circuit load.

We successfully realized the circuit control with K60 single chip microcomputer and divided each function according to the PCB circuit diagram.

We found a voice chip YF 017 series that can call multiple sounds. This chip has PWM output function and requires less stable operation. It only needs a 104 capacitor and can be used with a K 60 single chip microcomputer to make 32 sounds.

When we first improved the appearance design, because the design of the keys was not reasonable, during the redesign process, we made a sudden whim to make a detachable and replaceable key, with a total of two sets. A set of black keys and a set of white keys can simply realize the debugging of 7 + 4 segments of sound.

When using 3D printing to form the appearance, because the model is too large, it is divided into four parts, which is beneficial to the disassembly and assembly of hardware.

In view of the built-in charging port of charging treasure, we made a lead-out of the charging head and put it in the hidden part under the keys, which is beneficial to charging.

5. Innovation Point

1. Improve the appearance, really realize the miniaturization of the electronic organ, can be carried around, can be used in various indoor and outdoor occasions, is also suitable for different groups of people, is fun and easy to get started, is suitable for children to learn, and is also suitable for electronic organ lovers. The shell is implemented using 3D printing technology. Reduce costs.
2. Verifying the technology that the laser module and the camera are combined to determine the position together can be popularized in more technical fields.

3. The recognition range of intelligent laser keys has changed from dots to whole keys, improving the performance accuracy and enhancing the appreciation of music. 4. Use K60 MCU with faster operation speed and better performance to realize more algorithms and functions. With YF 017 series of voice chips, up to 32 pieces of voice can be freely called and combined through at least one IO port of the MCU, which can fully guarantee the voice calling of the laser piano and reduce the cost.

6. Conclusion

Based on the defects of the original electronic organ, the laser organ was designed and optimized. The initial starting point of the research was mainly to change the disadvantages of the traditional electronic organ, such as large size, inconvenient carrying, limited use, high price and difficulty in widespread popularization. The laser spot of the laser piano can achieve precise positioning, improve its appearance in the direction of easy popularization, enrich its playing content and expand its sound range, and at the same time make the laser piano suitable for different scenes and different crowds, not only full of fun and easy introduction, but also suitable for children to learn and for the majority of electronic piano enthusiasts. The laser keyboard represents the research direction of a new type of intelligent keyboard. With the incomparable size and price advantages of its traditional electronic keyboard, it saves space, is easy to carry, and achieves lightweight and convenient equipment. Through the reasonable choice of hardware, on the premise of fulfilling the performance task requirements, it also improves the performance accuracy, quasi-fluency, and enhances the appreciation of music.

References


