MATLAB App Designer-based Electronic Yankee Simulator

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Abstract: Dulcimer is a kind of common hammered string musical instrument in China, and it is also an indispensable instrument in Chinese national band. Add dulcimer timbre into electronic music, use composer's imagination, and create a good atmosphere for the further popularization and transmission of dulcimer folk music art. Using MATLAB software to realize a series of operations such as performance synthesis, processing and analysis of 402 dulcimer score, this paper studies the mathematical knowledge and computer processing algorithms involved in the skills of playing single tone and double tone, and carries out a series of processing and analysis of sound. Finally, create a dulcimer simulator app with MATLAB app designer. The designed dulcimer simulator is divided into three parts: teaching demonstration part, electronic dulcimer part and music score selection part. Dulcimer Teaching Simulator make us to play wonderful music with dulcimer anytime and anywhere. We can also choose favorite songs from existing music scores to enjoy the beautiful sound of dulcimer. The most important thing is to provide instructional animation teaching for beginners. By using the function of score singing and animation performance, beginners can learn the location of percussion and the transformation of different percussion techniques over and over again.

1. Introduction

Yangqin has been spread and evolved for nearly 400 years in China. No matter in musical instrument making, performing art or music creation, it has already had Chinese traditional characteristics and national style, and combined with local folk music, formed many schools with outstanding local and music characteristics. Nowadays, traditional music is performed by real orchestras, which requires more manpower and material resources, while electronic music does not; Electronic music producers can more directly control the timbre, tone, rhythm, strength and other music elements, and have better inclusiveness. From advertising soundtrack to animation background music, designers can play their imagination and creativity, and can not be limited by music styles. With the efforts of many electronic music lovers, It has developed a rich electronic music system.

Add dulcimer timbre into electronic music, give full play to the creator's imagination, and create a good atmosphere for the further popularization and dissemination of folk dulcimer art. Using MATLAB software to realize a series of operations such as performance synthesis, processing and analysis of 402 dulcimer score, this paper studies the mathematical knowledge and computer processing algorithms involved in the skills of playing single tone and Qi Zhu, and finally completes the electronic dulcimer simulator, and uses MATLAB app designer to create the electronic dulcimer interface, including the electronic dulcimer simulator, Dulcimer beginners teaching part, electronic dulcimer appreciation part.

2. Sound processing

Use the keyboard to play all the sounds of the dulcimer. From the point of view of signal processing, characteristic spectrum analysis is the core, and for continuous signal spectrum analysis, fast Fourier transform (FFT) method is mostly used. Its essence is to transform a periodic function into several trigonometric functions by means of a unique linear combination, which is called FFT transformation of the original function. FFT transformation is carried out on the original dulcimer sound, and the spectrum diagram obtained is shown in Figure 1
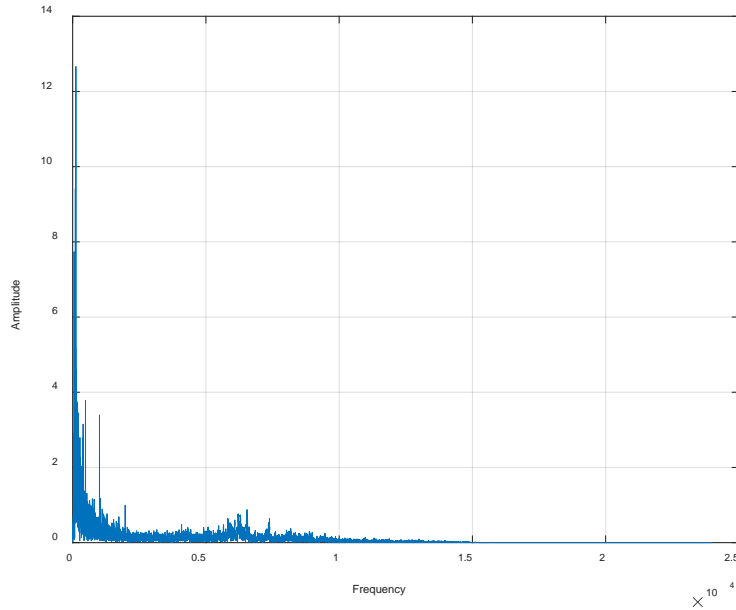
Fig. 1 Sound spectrum of dulcimer after FFT transformation

The spectrum diagram after FFT transformation is shown in Figure 1. By listening to the original sound and observing the spectrum diagram after FFT transformation, we can find that there is a certain amount of noise in the original sound, and the sound is not smooth enough. This paper attempts to denoise dulcimer sound by choosing FIR low-pass filter, median filter and wavelet filter.
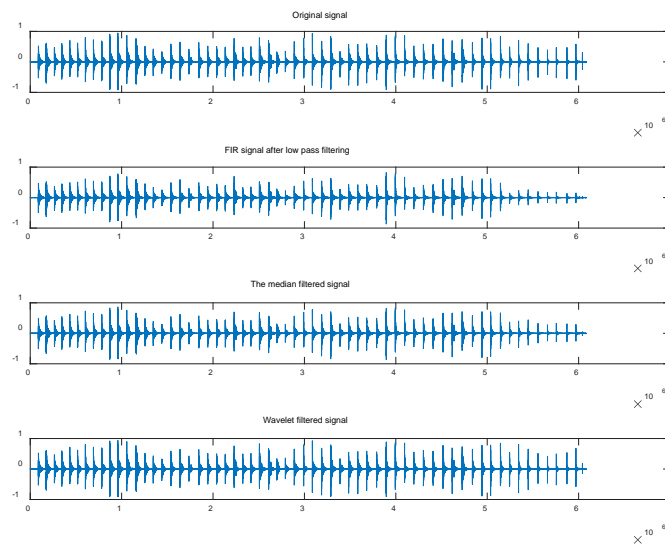

Figure 2 Signal comparison after denoising

The signal passing through an FIR filter is actually the process of convolution (shift multiplication and accumulation) between the signal and the coefficients of the FIR filter. Convolution of high-frequency or low-frequency signals with the filter model can clearly show the filtering of high-frequency and low-frequency signals by the filter; Median filtering is a kind of nonlinear signal processing technology which can effectively suppress noise based on sorting statistics theory. The basic principle of median filtering is to replace the value of a point in a digital image or digital sequence with the median value of each point in a neighborhood of the point, so that the surrounding value is close to the real value, so as to eliminate isolated noise points; The essence of wavelet de-noising is a function approximation problem, that is, how to find the best approximation of the original signal in the function space expanded by the expansion and translation version of the wavelet generating function according to the proposed criteria, so as to complete the distinction between the original signal and the noise signal. That is to find the best mapping from the real signal space to the

wavelet function space in order to get the best recovery of the original signal. Matlab is used to compare the signals obtained by the above three denoising methods as follows.

Through the comparative analysis of the three denoising methods, it is concluded that the FIR low-pass filtering denoising method is the best. Through figure 1, we can also find that most of the sound signals are in the low-frequency region, while there are few signals in the high-frequency region. In the sound signal, the high-frequency mainly reflects the details such as noise and edge. FIR low-pass filtering denoising can remove the high-frequency noise signal, and will not cause distortion to the original signal. After denoising, the sound becomes more natural, so the FIR low-pass filtering denoising method is selected to denoise the original sound.

3. App Design

Using MATLAB app designer to develop and design an app to realize a complete dulcimer simulator.
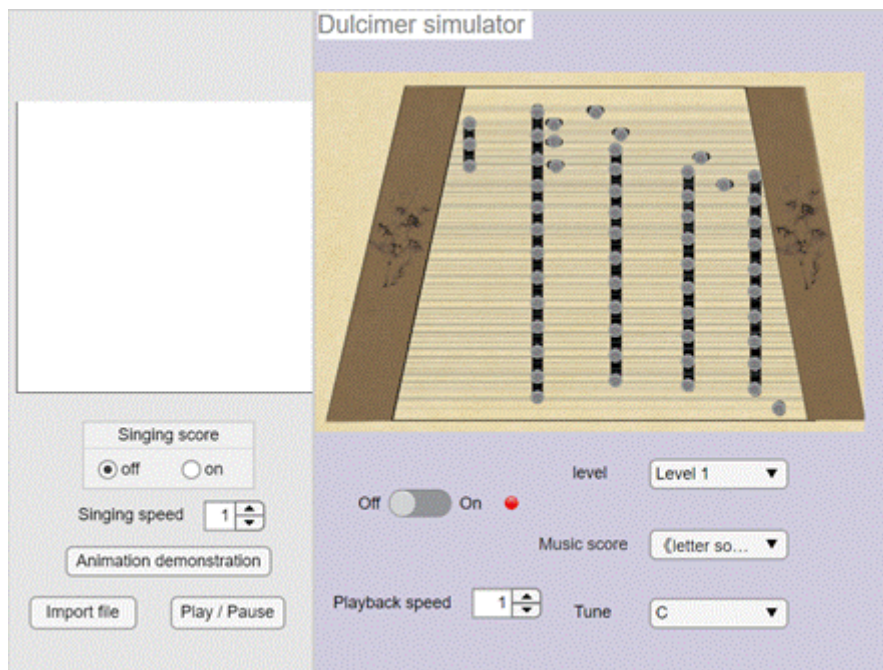
3.1 App interactive interface

Figure 3 App interface

As shown in Figure 3, the dulcimer simulator is divided into three parts: teaching demonstration part, electronic dulcimer part and music score selection part. The teaching demonstration part includes singing score playing and animation demonstration. If you specify a music score or input a music score and turn on the singing score playing switch, the music score singing demonstration and animation teaching will be carried out; The picture of dulcimer on the right is the part of electronic dulcimer. You can choose the percussion technique (single tone, plucking string, etc.) and click different percussion positions to make the sound of dulcimer playing; The music score selection part is used to appreciate the dulcimer music or listen to the dulcimer music composed by yourself. You can choose the grade, and then select some music scores in this grade to play, you can enjoy the dulcimer music; At the same time, you can choose not to choose dulcimer, but also choose to import a new score, play a new score, you can make it up by yourself, to listen to the effect. The three parts are not independent of each other. After selecting the music score, you can turn on the music score or animation play switch, and play dulcimer music and corresponding music score or animation percussion demonstration at the same time; You can also try to write a new score by tapping the electronic dulcimer.

3.2 App code writing

The code writing of MATLAB app designer can be completed in the code view, which is shown in Figure 4.The gray part of the code view is the default code generated automatically after the component is dragged into the canvas, which cannot be modified.
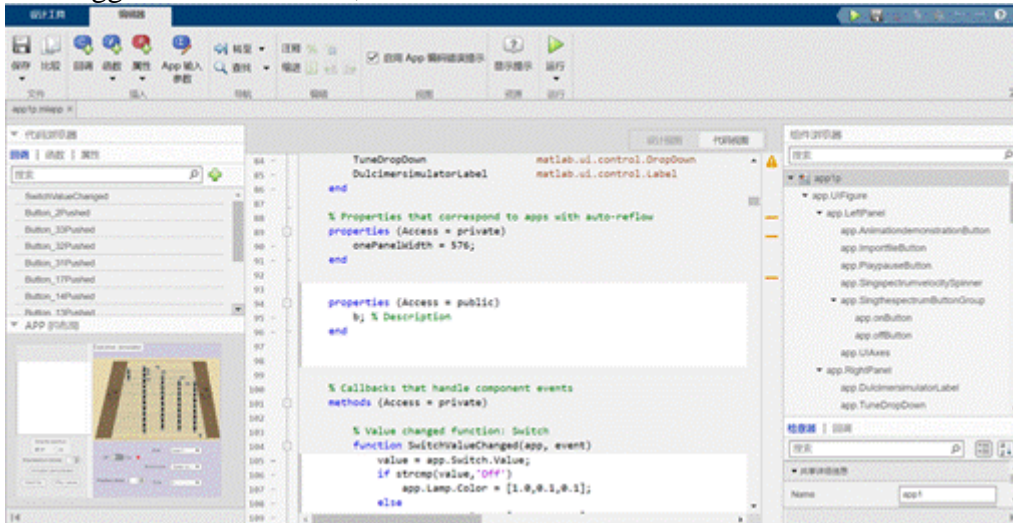

Figure 4 Code diagram

App designer can code app by adding callback function, function and attribute. Callback function is the core of code writing, which can be used to respond to user interaction.

To write the whole interface code, you need to import a blank app first, and divide the app interface into two parts.
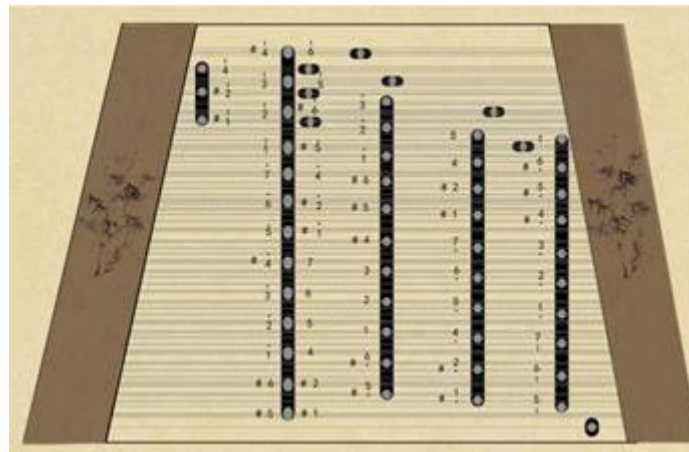
3.2.1 Electronic dulcimer

Figure 5 Dulcimer picture

Compare the appearance of the dulcimer, use the drawing software to draw the picture of the dulcimer as shown in Figure 5, and clearly draw the position of the dulcimer string and the dulcimer tapping point.

Import the drawn dulcimer picture on the right side of the app, add a button at each position where the bamboo is struck, add a callback function at each button, and click the button to play the callback function of the dulcimer sound at the corresponding position. In this way, the playing of the electronic dulcimer is completed, and we can click different positions to make it sound.

3.2.2 Music score selection part

Set the play switch button. If you use the music score to select play, open the switch button, edit the selection level, music score name and tone function with the drop-down box, and set the callback function for the selection level. The music scores saved in different levels are different, and the level

starts from the most basic music in the primary level, such as little star, find friends, pugAs shown in Figure 6:
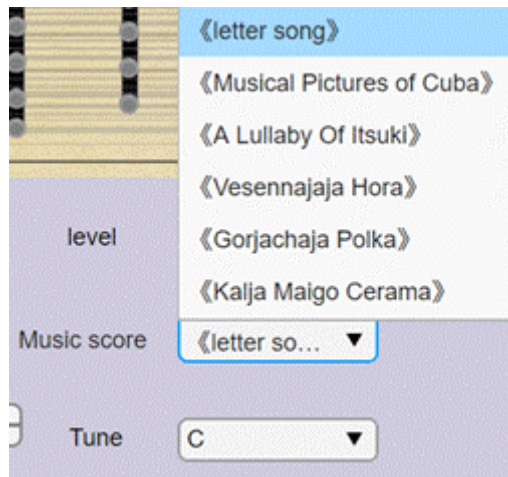

Figure 6 Example of music score selection

There are a large number of tracks in the song library. We can choose some to play. In the app interface, we can adjust the playing speed. The standard speed is 1. We can adjust the playing speed according to our preference or utility.

3.2.3 Teaching demonstration

This part is suitable for beginners to learn dulcimer performance, the first is to sing music function. Draw the existing music singing animation, and save the whole music singing animation as pictures.

In the upper left corner of MATLAB app, import the score display area, and put radio button group under the coordinate area as the switch of whether to sing the score. Use callback function to determine whether to sing the score in the coordinate area, and set callback function to the coordinate area. When a score is selected and the score switch is on, use imshow function to play the pictures decomposed by moving cursor animation one by one, In addition, the sound of the note corresponding to the cursor is played every time a photo is displayed, and the interval time and playback speed are also controlled by the playback speed spinner. In this way, the whole singing function has been completed.

For animation percussion demonstration, we need to first make percussion animations of different techniques, such as monosyllabic, Qizhu, plucking strings, etc., and make an animation of percussion at one position, as shown in the following figure:
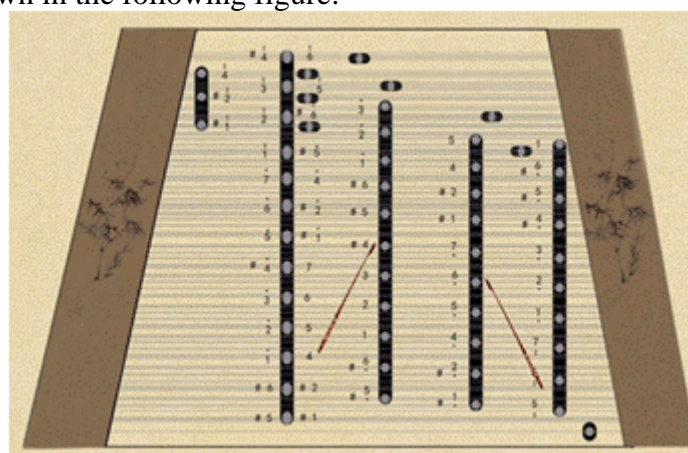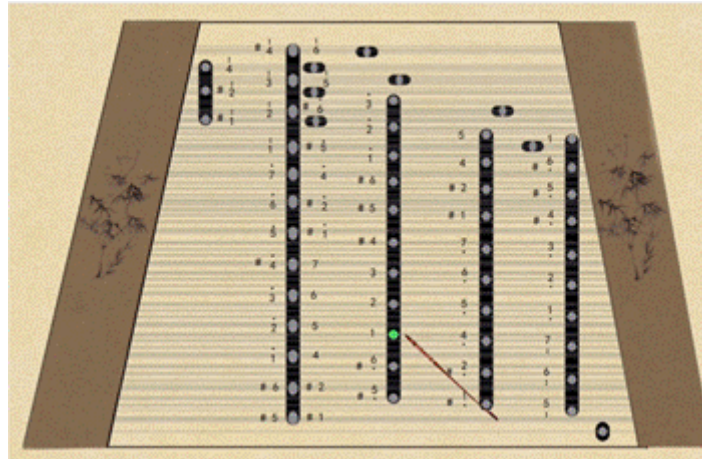

Figure 7 Animation demonstration

Figure 8 Animation demonstration (plucked string)

Make the animation of single tone, Qi bamboo, wheel bamboo and pluck string percussion action, divide the animation into a frame of pictures, when learning different music scores, use different order to call the animation, play out the whole demonstration video. In MATLAB app designer, insert the button to play the animation, add a callback function, and call the animation play movie function in the callback function. In this way, we can input the score or select the score to open the animation in the app and start the demonstration. Beginners can learn from the tapping position.

4. Conclusion

In this paper, the sound processing, first of all, wavelet de-noising to reduce noise, wavelet de-noising has the characteristics of low entropy, multi-resolution, de correlation and flexible base selection. The processed sound is very close to the sound of dulcimer playing. The app interface is developed by MATLAB app designer. Dulcimer simulator allows people to open the app to play dulcimer anytime and anywhere. They can also choose songs for dulcimer music appreciation. The most important thing is that beginners can learn animation playing, learn playing position and technique. Through a mobile device, we can start playing or learning dulcimer, which is our ultimate goal. It can make people play dulcimer anytime and anywhere and consolidate dulcimer learning more and more conveniently. The collision between Chinese traditional culture and Internet is developed in such an era, which has a positive effect on users. In the future, electronic dulcimer software will be more and more accepted by the public.

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