STM32-based music player design

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Summary: This design mainly studies the music player based on STM32 microcontroller, among them, the STM32F103C8T6 single-chip microcomputer is mainly used, LCD1602 monitor, LM386 power amplifier module, blue and white potentiometer, XY-V7B serial port controls the voice module, TF card, horn, KEY button. In addition to the hardware, software is required for system control. Finally, the mode of combining software and hardware is used, implementation status display, play music, music switching, the function of volume up and down. The chapter contains detailed information on various software and hardware and how to use them, this design optimizes the excessive display articulation, make the function more user-friendly, closer to the aspect of convenience and cost-effectiveness, it provides a more convenient way for music players.

Keyword: STM32 microcontroller; Music player; LCD1602 monitor

1. Introduction to the program

The STM32 microcontroller-based music player is stored by TF card, the system is composed of STM32F103C8T6 monolithic mechanism, the display content is displayed by the LCD1602 LCD screen, LM386 audio module, serial voice control module, and button composition. The software part also requires a C implementation assembly.

1. 1 The hardware scheme used

Select STM32F103C8T6 microcontroller for single-chip microcomputer□LCD1602 LCD module□LM386 audio module□XY-V7B serial port voice control module. The advantage of this solution is that TF cards can be used alone to store files, you can make the design play it separately after powering it up. at the same time, the XY-V7B serial port voice control module is relatively cheap, more suitable for design.

1. 2 Software design solutions

Software design is mainly divided into the main function, LCD display function, keystroke functions, as well as some delay functions and global variables that need to be called.

where the main function is the main function, the main function controls the operation of the key press, and the connection method of each serial port, so as to achieve the effect of sound wave playback and music switching, the function of volume up and down. The LCD4602 function will be programmed to display the status information of the song playback in real time.

Note: With the exception of the introduction to Chapter 1, each chapter should have a summary of the chapter.

2 Hardware implementation process

2. 1 Introduction to STM32 microcontroller

The single-chip microcomputer used in this STM32-based music player is STM32F103C8T6, the single-chip microcomputer cannot be used only with chips, therefore, it is necessary to design the necessary circuitry for packaging, it can only be used normally after encapsulation, there are different packaging methods depending on the implementation of different functions. Enough pins need to be left for packaging, in order to expand the application and the implementation of functions in the later stage.

2. 2 LM386 system design

The LM386 is an audio power amplifier chip.

The LM386 is an audio power amplifier manufactured by National Semiconductor, it has a wide frequency response□low power consumption、update internal link gain can be adjusted、wide voltage adaptation range, few external components and small total harmonic distortion, it has been widely used in various power amplification equipment.

The magnitude of the voltage gain is adjusted by means of a blue-and-white potentiometer.

2. 3 LCD1602 LCD module design

The display device used in this design is LCD1602 liquid crystal display module, mst portable handheld terminal products, such as mobile phones、navigation system、computers, etc, both have a small LCD display, this makes the design of LCD driver circuits an important part of handheld terminal design, and this design selects character display .

The choice of LCD is mainly low price, Good display, cost-effective.

Basic operation timing:

Read status: input: RS low, RW high, E high, output: DO~ D7=Status word.

Write instructions: input: RS high, RW low, DO~D7=Instruction code, E high pulse, There is no output.

Read the data: input: RS high, RW high, E high, output: DO~D7=Data.

Write data: input: RS high, RW low, DO~D7=Data, E high pulse, there is no output.

2. 4 Serial port voice module

The intelligent serial voice control module used in this design is XY-V7B.
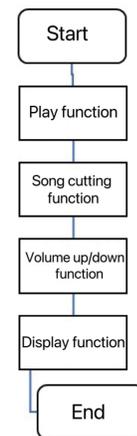

Figure 1　Software framework

The XY-V7B is an intelligent voice module, seven IO ports are integrated for segmented triggering, it is controlled by the UART serial port, single-bus serial port for control and other functions;the supported file format is MP3, WAV format, TF cards can be used, among them, the TF card can use 32G of the largest storage files, TF stored files can be changed via USB cable. The DAC output is 24-bit, dynamic range supports 91dB, the signal-to-noise ratio supports 84dB.

The serial voice module can store and read song files, Up to 255 songs can be played, the file form of the song can be in MP3 format or WAV format.

The song plays, time out, the volume needs to be increased or subtracted using a serial port program control, the specific control instructions are:

Table 1 Instruction Codes

directives	Instruction code	return
Play	AA 02 00 AC	not
Time out	AA 03 00 AD	not
Stop it	AA 04 00 AE	not
Previous song	AA 05 00 AF	not
Next song	AA 06 00 B0	not
Volume plus	AA 14 00 BE	not
Volume down	AA 15 00 BF	not
Previous file	AA 0E 00 B8	not
Next file	AA 0F 00 B9	not
End playback	AA 10 00 BA	not

Specific to the button, the first button is to start pause, the second button is Volume Plus, the third is volume reduction, the fourth is the previous song, The fifth is the next song.

2. 5 Brief summary

The function implemented by the program is to connect the various pieces of hardware in series, then join the specific operation process, thus realizing the functionality. The switching circuit and method used by the single-chip microcomputer, a combination of hardware and software is adopted, it solves the problem of complex circuits when simply using one key to switch on/off, it also avoids the problem of cumbersome operation and large space occupation when using two buttons, the beneficial effects are significant. It can be seen that the success of this design is inseparable from the combination of software and hardware.
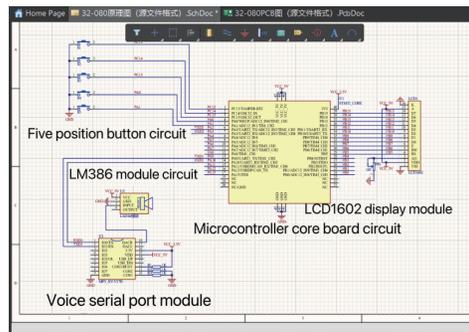

Figure 2 Final schematic of the STM32-based music player

3 Software-wise

3. 1 Main function

The most important thing in a program is the main function. it can complete the function realization of the key, and the role of calling various devices. First, the main function needs to call a series of header functions, for example, the delay function, functions that connect other functions, etc. The next step is to set the 16 decimal number of the command to call. The name of the command also needs to be displayed in characters, where starts with "Play", pause to "Pause", volume is added to "Vol+", reduce the volume to "Vol-", the next track is "Next", the previous track was "Previous", where the switch between display requires calling a delay function for excess, excessive times are indicated by blanks. Next is the connection of keys and commands, enables the commandment of the function to correspond to the physical keystroke.

3. 2 LCD1602 functions

The LCD1602 is the display module, the function of this block is mainly to connect the corresponding port, so that the information can be displayed accurately. First, you need to turn on the clocks for each port. It is then called based on the performance and characteristics of each port. Make port data available to connect features along with information.

3. 3 Firing of software

The firing of the software requires the use of MCUISP software, this software is a third-party microcontroller download software, its operation is simple, easy to use. An MCU is a microcontroller, that is, a microcomputer, ISPs are programmed in the system, therefore, this

software is equivalent to the compilation of computer software can be directly connected through USB adapters, finally, the programming program is realized to the single-chip microcomputer.

3. 4 Brief summary

Hardware is the foundation of design, software, on the other hand, is how the hardware is driven to the correct instructions.

Software is especially important in the overall design, through the combination of software and hardware, the execution of the design can be achieved, meantime, software can also optimize the shortcomings of the hardware through some algorithms, it could also be a little more humane. Thus, software is very important, it can even improve the comfort of the design.

4 Results showcase

4. 1 Hardware soldering

First of all, in terms of hardware, we need to prepare STM32F103C8T6 microcontroller, this microcontroller is the core of the design;secondly, you need to prepare the LCD1602 liquid crystal display, this is a device that implements real-time status information;then a blue-and-white potentiometer is also needed, this adjusts the increase in the design voltage;LM386 This is a carrier for adjusting amplitude and connecting speakers;serial port voice module, this is storing data, enables the player to play any part of the song. The above are the main components, Secondly, there are several 1K resistors, 5 buttons, TF card, multi-use board, conducting wire, Solder.

The soldering of the hardware requires the use of an electric soldering iron, when using it, you need to pay attention to the phenomenon of no short connection.

4. 2 Overall testing

Start with a power-on test.

The function is normal, "Pause" is shown, indicates that the power is successful at this time, the software ran successfully, the status at this point is paused. Next, play it:
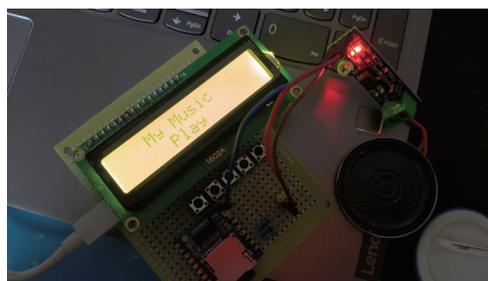

Figure 3 Play the test

Press the play button, "Play" appears, indicates that the playback display is normal, if a sound appears, it means that the playback is normal, but found the sound quality mixed, the voltage gain is not correct, adjust the size of the blue and white potentiometer and volume keys, after adjustment, the sound quality was found to be pure, volume adjustment is also normal, the volume display is also normal, Feature implementation succeeded.

Finally, test the switch song function, the song is used normally in the previous track and the next track switch, everything works fine, the function is implemented, at this point, the STM32-based music player function has been fully realized.

4. 3 Brief summary

There are many difficulties when testing, for example, you need to download the driver when firing, it is also necessary to break the circuit microcontroller. The noise of power-on is loud. at one point, I felt like I had failed my design, after adjusting the blue and white potentiometer, everything works fine. The screen does not light up after powering on, it turned out that there were problems with welding. Some of the problems were not understood before, some problems are caused by mistakes, in short, explore step by step, let me improve a little bit, finally, the design of the STM32-based sound player was completed.

5 Conclusion

Music is an effective way to relax in a stressful environment , so it makes sense to design a music player, the focus of this design is on the application of what has been learned, for example, the use of STM32, C language compilation and debugging, etc. Among them, the algorithm design of C language is the most difficult and the most core. The use of various devices and software has been particularly helpful to me. it not only allows me to use what I have learned and thought, it can also lead me to a broader path. At the same time, it deepened my flexible use of hardware and software.

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