

## MP3 Multi-function Player based on STM32

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### Abstract

**This design is mainly a MCU control of the creation of MP3 player, to achieve a variety of playback functions, a variety of storage methods, you can use U disk storage, can also use memory card storage, and through the key to switch the disk sign; Change the way the song is played in a loop; To randomly switch the top and bottom songs; The current time of playing songs, the number of songs in the storage medium, which song is currently playing, and the clock are all clearly displayed on TFT; Divide left sound channel and right sound channel adopts double loudspeaker to support stereo; Support mobile phone computer and other equipment output audio, to achieve the function of small speakers. The main modules of this design are STM32F103C8T6 minimum system module, XY-V17BMP3 module, LTK5128D class power amplifier module, DS1302 clock module, speaker module, LCD display module.**

### Keywords

**MP3 Player; STM32F103C8T6; Speaker Module; TFT-LCD Display; USB SD Card.**

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## 1. Introduction and Background

Leap period of the 21st century is the social development, all kinds of technology development, the development of electronic technology is very outstanding, with the deepening of the embedded system, make People's Daily life is becoming more and more inseparable from the electronic products, which occupies every aspect of daily life, people are receiving daily and feedback, source of information is also varied, during this period, People urgently need to get the latest information and use information at any time. This problem can be solved by electronic products, which are slowly entering people's life and thus changing the original way of life [3]. Now there are a lot of people in the consumer electronics industry, involved in the product field and the electronic industry is more and more. In 1998, Samsung launched the world's first MP3 player MPManfio, so the development speed of the MP3 player market has become extremely rapid, into a stage of rapid development, the function of MP3 is becoming more and more powerful. After years of development, MP3 is not just an audio player, its function has received very good extension, for hard drives, chip, LCD display and other major technology is also a very good improvement, now, multi-function, low cost of the manufacture of MP3 player for people is not the problem, therefore, Many electronic manufacturers have also begun to study the functions of MP3, such as the use experience, network connection, page display design and intelligent improvement, so as to achieve a great upgrade of MP3 players, which also expands the new ideas for the development of the MP3 market [7].

## 2. A brief introduction to the functions of MP3

Use the key to control the STM32 microcontroller module of different ports, mode key can change three different modes, so as to achieve different functions under different modes. In the case of mode

0, press the corresponding button to control the switch and pause function of the song by controlling the MP3 voice module, and reduce the distortion rate by the power amplifier module to make the sound quality more outstanding. At the same time, the information data of the song and the time state of the current song will be updated. And the updated time data through the clock module are displayed synchronously on the LCD screen [4]. In mode one, the size of the audio can be adjusted by controlling the MP3 voice module so that it can play songs on an SD card or on a USB disk. The quality of the audio can be changed through an amplifier module that we use. At the same time to change the quality of the audio is to use it to achieve, but also to update the time, mainly through the DS1302 clock module to achieve, and the above to achieve things are displayed on the LCD flat. Songs fast forward the time of 5s and back 5s, are implemented in mode two, in this mode can not only through the MP3 module to achieve fast and annealing time, and can also change the way different cycle of songs played, at the same time and use the power amplifier module to change mode zero had the same quality, but also to update of time, It is mainly achieved through DS1302 clock module, and the update of the above data should be displayed on the LCD flat [8]. The overall design structure of the system is shown in Figure 1 below.

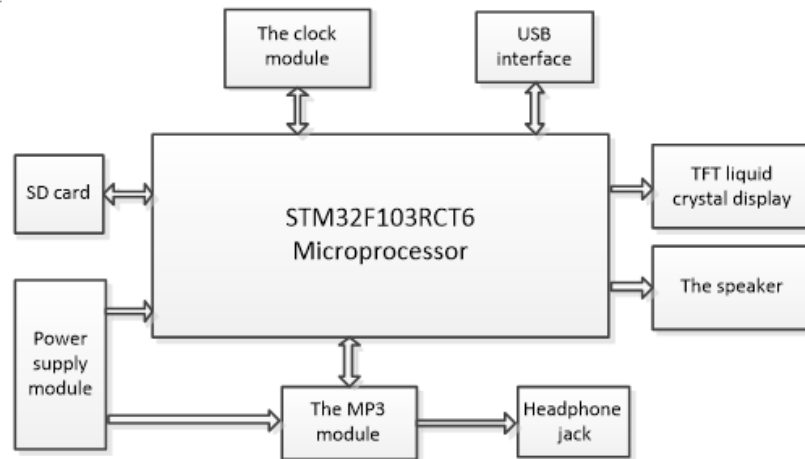


Figure 1. Overall design of the system

## 2.1 Selection of main modules

### 3.1.1 Single chip microcomputer

MCU is a kind of circuit chip integrated by VLSI technology [9]. STC89C52RC MCU is an 8-bit microcontroller, the operating procedure is very simple and convenient, and low power consumption, the microcontroller also has the advantages of small size and high performance for some simple programs or just begin to learn microcontroller starters, the single chip microcomputer is a good choice, with the emergence of a lot of high quality single chip microcomputer, The price of the SCM has become cheaper and cheaper, and the functions are relatively perfect. However, the IO port resources of the SCM are too little used, so it cannot realize some complex functions. Select another powerful single chip microcomputer STM32F103C8T6, this is a 32-bit microcontroller, its memory is composed of 256KB program FLASH and 48KBRAM, with DMA, motor control PWM, PWM and other functions, its performance is very powerful, and the use of resources is also a lot. It also has the advantages of small size, low power consumption and cheap price, which is favored by researchers. The IO port of STC89C52RC is obviously much less than that of STM32F103C8T6. Although the price difference is not big, the functional implementation is different. For researchers who want to study some complex projects, STM32F103C8T6 can be more widely used by people.

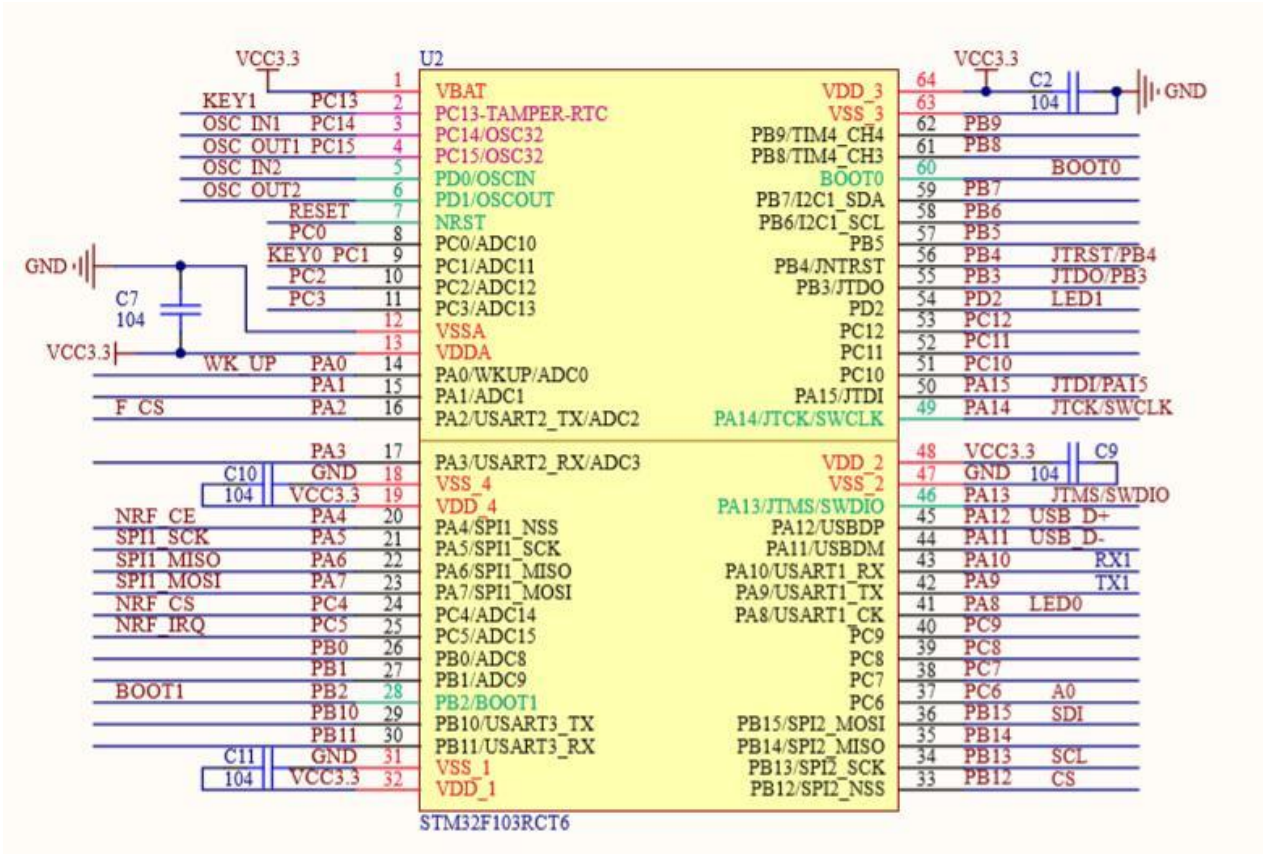


Figure 2. STM32F103 minimum system

STM32F103C8T6 MCU module is the core module of the whole design, and the pin function of its chip is shown in Figure 2. The program storage capacity is 64KB, RAM capacity is 20KB, and the main frequency can reach up to 72MHz. It is not only cheap and popular among researchers, but also has high performance and high compatibility in the case of low power consumption. In addition to the main chip, STM32F103C8T6 minimum system board has three main circuit parts: Power supply, crystal oscillator and reset. Its circuit design is shown in Figure 3 and Figure 4.

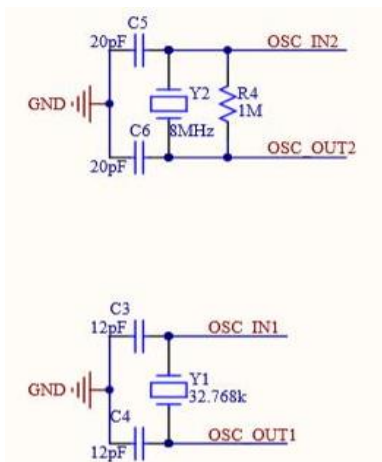


Figure 3. Crystal oscillator circuit

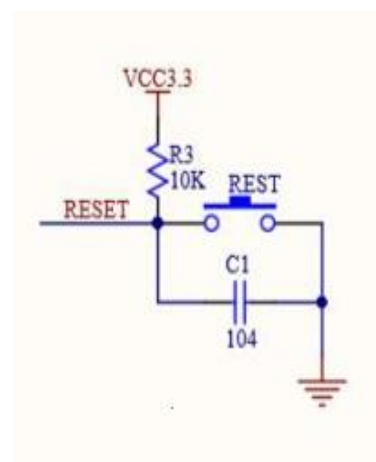


Figure 4. Reset circuit

### 3.1.2 MP3 module

JQ8900MP3 module is a voice chip, around a DAC audio sound channel output, function is various, sound quality is good, price cheap is widely used, there are many kinds of control mode, easy

operation, simple directives can be generated automatically, can will load audio show the best sound quality effect, but the module is no fast forward and backward this two functions, Not for the MP3 functions we need to add. For XY-V17BMP3 module, which is an intelligent voice module, can work in different configurations; Small size, easy to carry, low power consumption, stable performance, and this module can also obtain the information state of music, and has the function of fast forward and backward, the price is comparable to the JQ8900MP3 module [10]. XY-V17BMP3 module has more stable performance and more functions.

XY-V17BMP3 module is an intelligent voice module, with a very unique triggering way, the control method is also adopted on the One\_Line single bus of a serial port control, through a series of UART serial port control on the chip to achieve voice broadcast this function, including most of the basic functions such as MP3 [6]. You can use what kind of way to play the control, can be on the song can suspend the operation of the control, can be on the song can choose and change the audio too large or too small control and other functions. The XY-V17B chip is very suitable for this design, transmitting hexadecimal data through a serial port [5]. The pin interface for this module is shown in Figure 5 below.

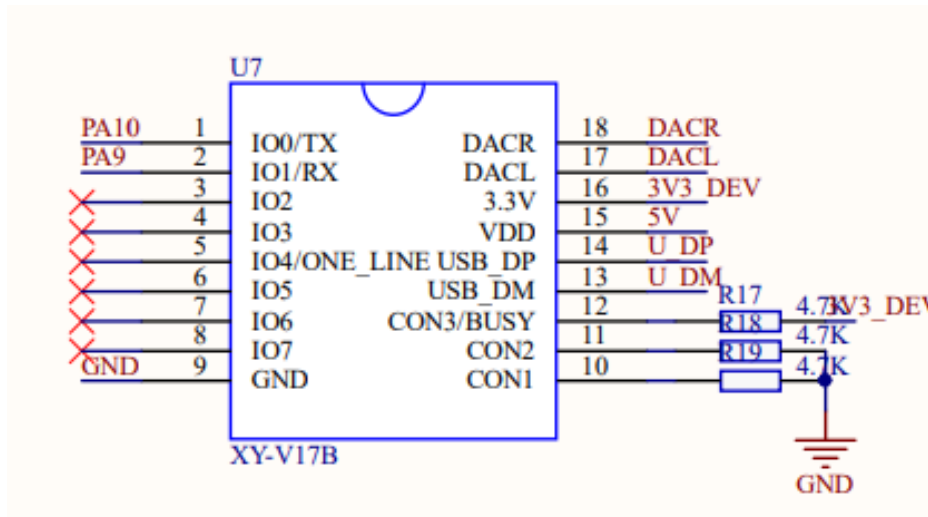


Figure 5. XY-V17B MP3 module

### 3.1.3 Power amplifier module

LTK5128AB class power amplifier module, its working voltage is 2.5V to 5.5V, the output power is 3W to 5W, the circuit design is simple, the low frequency is rich, but the power amplifier efficiency is low, only about 30%, the phenomenon of heating from time to time appears on the chip, especially in the case of high power is more common, the cross distortion phenomenon is unavoidable. This often occurs in the case of a low signal, resulting in poor audio quality and a high price that is difficult to accept. LTK5128D class power amplifier module, the working voltage of this kind of power amplifier is between 2.5V and 5.5V, the same as the working voltage of AB class, and the power amplifier power is higher than 90%, the sound quality effect is good, the occupying volume is small, convenient and easy to carry, in the case of no heat sink, it will not affect the sound quality because of the temperature change, the effect is good, LTK5128D class power amplifier power is large, low distortion rate, not affected by temperature, excellent sound quality, with LTK5128AB class power amplifier does not have the unique characteristics, the price is relatively low, widely used.

LTK5128D class power amplifier working voltage of 2.5V to 5.5V, short circuit current protection and under-voltage protection, has the characteristics of low noise, low distortion, a variety of power encapsulation mode, will not change with the change of temperature and sound quality, Byp capacitor determines the opening time of the power amplifier chip, at the same time will affect the noise of the chip, power supply rejection ratio and other important performance. The pin interface for this module is shown in Figure 6.



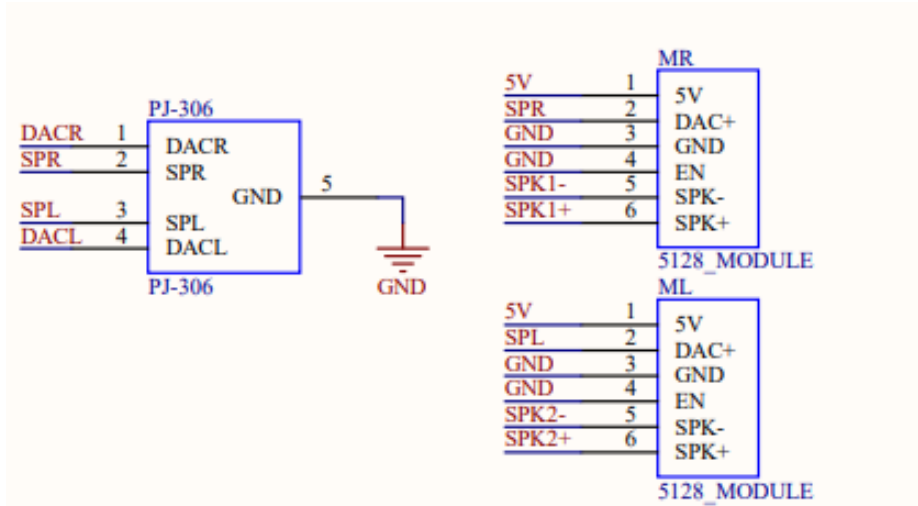


Figure 6. LTK5128D class power amplifier module

### 3.1.4 Display module

LCD1602 display module: We in undergraduate study, is often used display LCD1602, program implementation is very simple, the price is low, but the volume is larger, looking at is not too beautiful, connected to the microcontroller when using too much port of microcontroller, display capacity is limited, can support a variety of color display, but the Chinese cannot display, Only for small projects [1]. TFT-LCD screen has a resolution of 128×128, and low power consumption, can control the color of the font, according to their preferences and function Settings to choose different color configuration, can carry out the Chinese character input display, program design is relatively simple, in the bottom can be found, using SPI communication mode, The I/O port used in the configuration of SCM is very few. When the amount of data to be displayed is large, multiple lines are required to be displayed at the same time. This liquid crystal display can be realized with relatively perfect functions.

The LCD screen used in this design is a TFT screen, which uses a 1.3-inch display screen to display data information, and can also adjust the display direction of data on the screen. The pin interface circuit is shown in Figure 7.

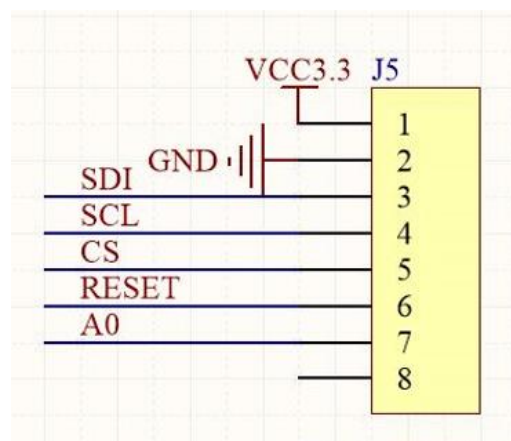


Figure 7. TFT-LCD LCD display module

## 3. Application and Prospect

With the continuous progress of science and technology at the present stage, people's pursuit of high-tech things has become more and more urgent. A good technical product can bring people a lot of convenience [2]. In the design process of MP3, we should not only realize more practical functions, so that people will not think that mobile phones or computers will replace it, but also bring better

experience to consumers and bring more convenience. By analyzing the design of MP3 multi-function player based on STM32, the following conclusions can be drawn: At present, for the design of MP3 player, the main core module used is STM32F103C8T6 microcontroller module, which has strong performance and many resources; For MP3 module, voice module on the market has a lot of, but each have their respective advantages and disadvantages, when we are in the choice, need to see in the design process, we need to realize what function, should meet the performance requirements for what, but with the continuous development of technology, new technology will replace the old technology, we want to see from the view of development, to make a good product.

#### 4. Conclusion

This paper introduces several main modules of MP3 multi-function player based on STM32: MCU module, MP3 module, power amplifier module and display module. Several existing modules on the market have done a general comparison, so as to choose more suitable for the design of the module. For different design requirements, we need to choose different models of modules, integrate the advantages of each module, and improve some deficiencies, is expected to further design a more complete function and performance of the MP3 player.

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