2018 International Conference on Computational Science and Engineering (ICCSE 2018)

# Design and Implementation of Music Enjoyment Digital Music Box Based on Single Chip Microcomputer Control

**Ya'ning Yan**

Xi'an Peihua University, Xi'an, 710125, China

394811297@qq.com

**Keywords:** AT89C51, LCD display, Buzzer

**Abstract:** With the development of human society, people put forward higher and higher requirements for the enjoyment of vision and hearing. A little music box can bring good memories to people and enhance people's spiritual and cultural enjoyment. The traditional music box is mostly mechanical, cumbersome and monotonous, and cannot achieve mass production. This design is a digital music box based on AT89C51 Series MCU. The music box is mainly composed of key circuit, reset circuit, clock circuit, display circuit and buzzer. Four keys are used to control the music box, two of which are used to control the playback and pause of songs, and the other two are used to control the change of song order on the LCD. When playing the song, the corresponding song corresponds to the song sequence and song name display on the corresponding digital tube. Finally, Proteus Software is used to simulate the design system and test whether the function of the system can be implemented normally.

## 1. Introduction

With the progress of science and technology and the development of society, the information that human beings come into contact with is increasing and becoming more and more complex [1]. Faced with the vast amount of information, people have been able to use computers and other tools to process it efficiently and accurately, but in order to process the information in a timely and clear way to others, we must also be tired of seeking more excellent display technology to achieve. The combination of single-chip computer technology and liquid crystal display technology makes information transmission and communication develop rapidly towards intelligent visualization. A little music box can bring good memories to people and enhance people's spiritual and cultural enjoyment. The traditional music box is mechanical, cumbersome, monotonous, and can not achieve mass production. The music box designed in this paper is an electronic music box with single chip computer as its core component. It is small in size, light in weight, can play and rotate music, has many functions, colorful appearance, easy to use, and has certain commercial value.

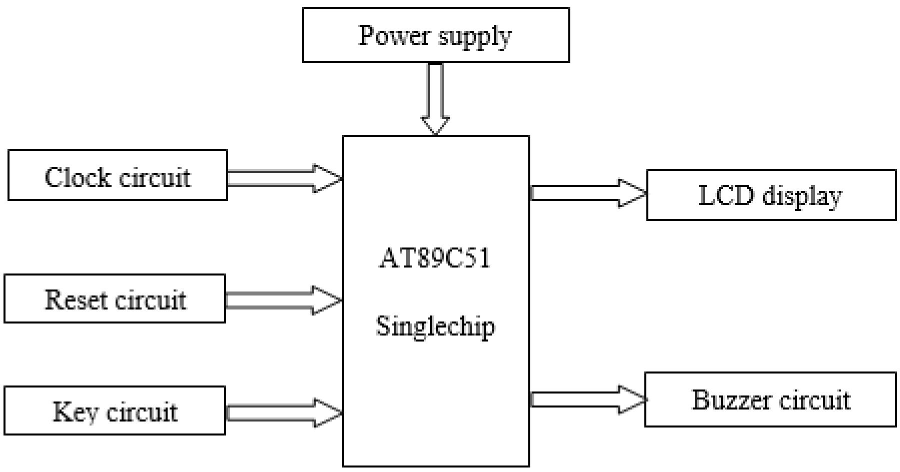


Fig. 1 Basic working principle block diagram

  DOI: 10.25236/iccse.18.063

This design is a music box based on AT89C51 single chip computer. The music box mainly consists of key circuit, reset circuit, clock circuit, buzzer and display circuit. Two keys are used to control playback and pause, and the other two buttons are used to control the song changing. There are three pieces of music, which can be displayed on the LCD to replace the tracks. For each song played by the buzzer, the corresponding song sequence will be displayed on the LCD. The block diagram of the system is shown in Fig. 1.

## 2. System Hardware Design

### 2.1 AT89C51 Chip Function.

T89C51 is a low-voltage, high-performance CMOS 8-bit microprocessor with 4K byte flash memory, programmable, erasable read-only memory, commonly known as MCU. The device is manufactured using ATMEL high density non-volatile memory technology and is compatible with industrial standard MCS-51 instruction set and output pin. ATMEL AT89C51 is an efficient microcontroller, which provides a flexible and inexpensive scheme for many embedded control systems because of the combination of multi-functional 8-bit CPU and scintillation memory in a single chip. At the same time, AT89C51 can be reduced to 0 Hz static logic operation, and support two software options of power saving mode. The idle mode stops CPU work, but allows RAM, timing counter, serial communication interface and interrupt system to continue to work. The power-off mode saves the contents of RAM, but the oscillator stops working and prohibits other components from working until the next hardware reset [2].

### 2.2 Oscillator Characteristics.

XTAL1 and XTAL2 are the input and output of the reverse amplifier respectively. The reverse amplifier can be configured as an on-chip oscillator. Shi Jing oscillation and ceramic oscillation can be used. If the external clock source driver is used, the XTAL2 should not be connected. Excess input to the internal clock signal needs to pass through a two-frequency flip-flop, so there is no requirement for the pulse width of the external clock signal, but the required width of the high and low levels of the pulse must be guaranteed.

### 2.3 Chip Erase.

Eradication of the whole PEROM array and three locking bits can be accomplished by combining the correct control signals and keeping the ALE pin at a low level of 10 ms. In chip erase operations, the code array is written "1" and must be executed before any non-empty memory bytes are reprogrammed. In addition, AT89C51 has steady-state logic, which can support two software alternative power-off modes at low to zero frequencies. In idle mode, CPU stops working. But RAM, timer, counter, serial port and interrupt system are still working. In power-down mode, the RAM content is saved and the oscillator is frozen, and other chip functions are prohibited until the next hardware reset.

### 2.4 LCD Display Screen.

LM016L is a dot matrix LCD module specially designed to display letters, numbers, symbols, etc[3][4]. It consists of several dot-matrix character bits. Each dot-matrix character bit can display a character. There is a spacing between each bit, and there is a spacing between each line. It plays the role of character spacing and line spacing. The display principle of various graphics in liquid crystal display: dot matrix graphical liquid crystal is composed of M*N display units. Assuming that the LCD display screen has 64 rows, 128 rows, each row corresponds to 8 bits of 1 byte, that is, each row is composed of 16 bytes, 16*8=128 points. 64*16 display units on the screen correspond to 1024 bytes of display RAM area, and each word corresponds to 1 byte. The contents of the festival correspond to the brightness of the corresponding positions on the display screen. For example, the brightness of the first line of the screen is determined by the content of 16 bytes of 000H-00FH in RAM area. When (000H) = FFH, there is a short brightness line in the upper left corner of the screen, which is 8 points in length. When (3FFH) = FFH, there is a short brightness line in the lower right corner of the screen; when (000H) = FFH, (001H) = 00H, (002H) = 00H... When (00EH) = 00H, (00FH) = 00H, a dotted line composed of eight bright lines and eight dark lines is displayed at the top of the screen.

**2.5 Key Circuit.**

Keyboard can input data and transmit commands to MCU in the application system of MCU. It is the main means of manual intervention to MCU. Whether the key is closed or not is reflected in the output voltage of the line showing a high or low level. If the high level indicates that the key is disconnected, the low level indicates that the key is closed. By detecting the level of the line, we can confirm whether the key is pressed or not. In order to ensure that CPU only recognised one button at one time, the effect of jitter must be eliminated. P10P15 is used as the control button, in which P10.P11 scans rows and P14-P15 scans columns; the swing music, pause and play can be selected by function keys. Fig. 2 is the key circuit.

**2.6 Reset Circuit.**

In order to make the CPU and the components of the system in a definite initial state and work from the initial state, the reset of the single chip computer is needed when it is started. The reset letter of the 51 Series MCU is introduced from the RST l trigger into the Schmidt trigger of the chip. When the system is working normally and the oscillator is stable, if the RST pin has a high level and maintains more than two machine cycles (two oscillation cycles), the CPU can respond and reset the system. The reset methods of the single chip microcomputer system are: manual button reset and power on reset. Fig. 3 is a reset circuit.

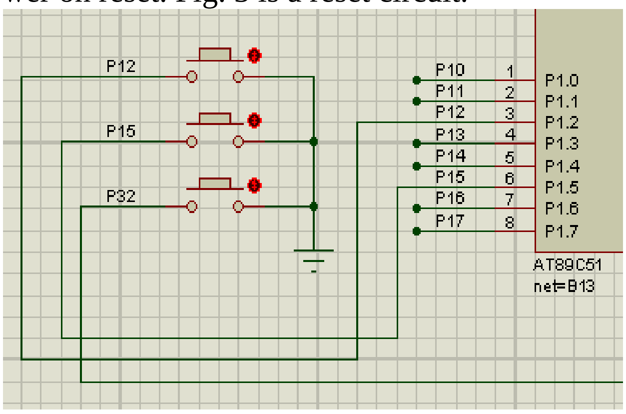


Fig. 2 Key circuit

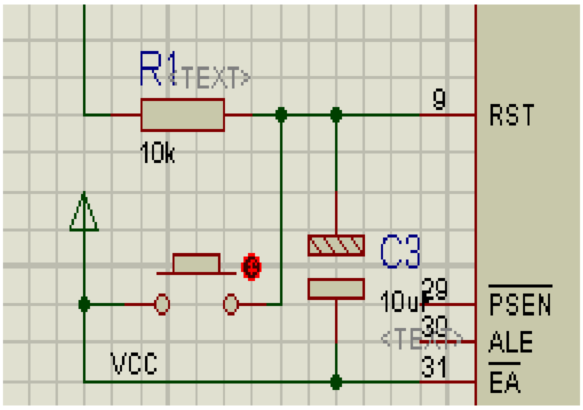


Fig. 3 Reset circuit

**2.7 Clock Circuit.**

Clock circuit plays a very important role in MCU system and is the basis to ensure the normal operation of the system. In a single-chip application system, clock is the reference oscillation timing signal to ensure the normal operation of the system. It mainly consists of crystal oscillator and peripheral circuit. The magnitude of crystal oscillation frequency determines the speed of the single-chip system. In order to meet the requirement that the oscillation period is 12MHZ, the crystal oscillator of 12MHZ is used here, and there are two 22Pf single-crystal capacitors. The two crystal oscillation pins are connected to the input pins of XTAL1 and XTAL2 oscillation pulses, respectively. As shown in Fig. 4.

**2.8 Buzzer Drive Circuit.**

Because the working current of the sonar is generally large, the I/O of the single chip computer cannot be directly driven (but AWR can drive low-power humming device), so it needs to be driven by amplifier circuit. Generally, triode is used to amplify electricity. Flow is OK. The buzzer driving circuit generally includes the following parts: a triode, a buzzer, a continuous current diode and a power filter capacitor. Fig. 5 is a buzzer drive circuit.

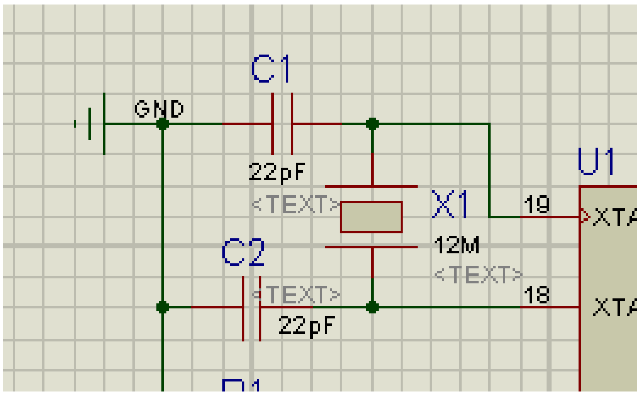


Fig. 4 Clock circuit

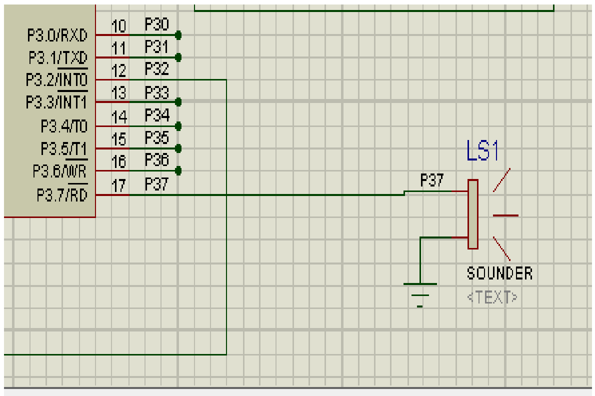


Fig. 5 The speaker driver circuit

## 3. System Software Design

### 3.1 Software Design Flow Chart.

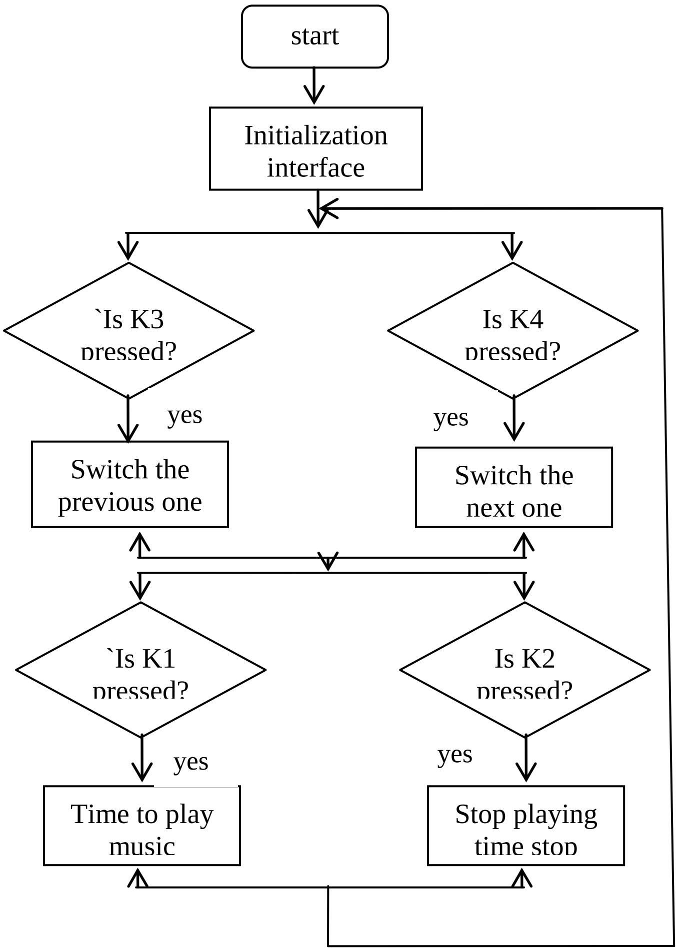


Fig. 6 Software design flow chart

The system software design flow chart is shown in Fig. 6. After pressing the power switch, the whole circuit starts to operate, and the power tracing indicator lights up. At this time, press the switch button connected to ports P14 and PL5 to select songs. Each click, the singlechip will change the songs in sequence, and display the song order and the song name on the LCD. The song order and title will be presented in the form of text "1 + song name, 2 + song name, 3 + song name" on the digital tube. When the switch button connected to P1.0 is pressed, the singlechip will play the song sequentially, and when the P11 switch is pressed, the song playing will be suspended.

### 3.2 Determination of Beat.

To compose music, it is not enough to have tones alone. It also needs rhythm, so that the music has a fixed rhythm, and can adjust the speed of each tone. If the 1 is 0.5s, then the 1/4 is 0.125s. As for how many s the 1 shots are, there is no strict rule. The immediate value of the duration of a voice is usually expressed in terms of the number of shots. The rest indicates a pause. A piece of music is composed of many different notes, and each note corresponds to different frequencies, so that different frequency combinations can be used to delay the number of beats to form music. Understanding some of the basic knowledge of music, we know that the production of different frequencies of audio pulses can produce music. For MCU, it is very convenient to generate pulses of different frequencies. The timing/counter of MCU is used to generate such square-wave frequency signals. Therefore, it is necessary to clarify the relationship between musical notes and corresponding frequencies, as well as the timing and counting of single-chip computers.

### 3.3 Determination of Coding.

Do re mi FA so La sit is coded 1-7, accented do is 8, accent re is 9, pause is 0. Play length is in the unit of + sextant (165 MS in this program). One beat means that the quadruple is equal to four sixteen notes, which is coded as 4. The other play time is analogous to that. Tone is coded as high as 4 bits, while playback time is low as 4 bits, so tone and rhythm constitute a coding. Use 0xff as the end of the score. For example, 1: tone o, pronunciation length is two beat, that is two minute note, encode it to 0218.

### 3.4 Simulation and Results

Simulation debugging is carried out on Proteus Software. As shown in Fig. 7.

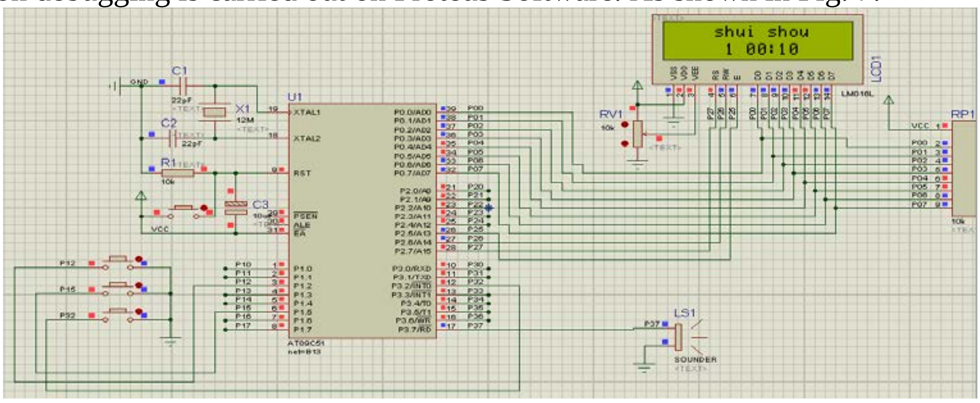


Fig. 7 Initial interface of simulation

Simulation run: point second buttons (start / pause key) and start playing the first song. Switch the song through the first (last song) and the third (next) key. As shown in Fig. 8.

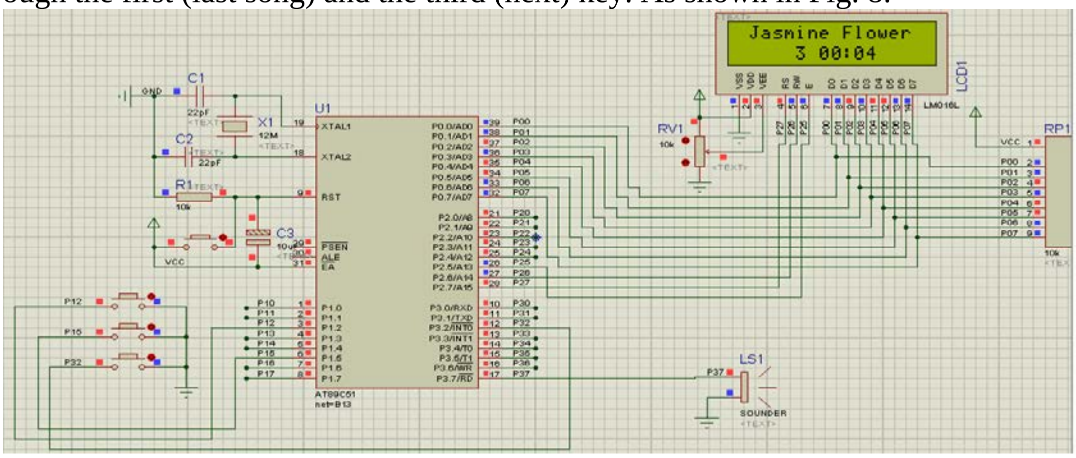


Fig. 8 Simulation playback interface

## Acknowledgements

2018 Shaanxi Education Science Planning Subject (Grant No. SGH18H517)


## References


[1] W.Lu. Design of digital music box based on single chip microcompute [J]. Digital Technology and Application, 2016, (6): 194-195.

[2] Q.L.Li. Principle and Application of Single Chip Microcomputer (C51 programming) [M]. Beijing: Higher Education Press, 2013.12.

[3] Y.Tian. Research on function diversity of SCM Music Player [J]. Journal of Jinhua College of Profession and Technology, 2013, (6): 33-34.

[4] R.T.Liu. Mass Data Processing Design and implementation of electronic music player [J]. Value Engineering, 2014, (4): 152-153.