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BACHELOR THESIS

Paper Title Simulation design and implementation of electronic music doorbell based on proteus

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summary

With the advancement and development of the times, intelligent control, miniaturization of instruments, and miniaturization of power consumption have received widespread attention. In these fields, single-chip microcomputers play a pivotal role, which elevates the application of single-chip microcomputers to an important position, and the design of single-chip microcomputer application systems has become a new technical hotspot.

As an important information exchange tool in people's daily life, the doorbell was originally set up to remind the owner of visitors by ringing the bell, instead of shouting outside the door. With the gradual development of single-chip microcomputers, the functions of electronic music doorbells have become increasingly perfect, from a single tone to beautiful music, from a small button to a visual panel, and adding the function of a clock. It not only perfectly solves the singleness of traditional doorbells, but also increases the user experience.

This design is based on AT89C51 single-chip microcomputer, and mainly adopts interrupt programming. The system includes clock circuit, reset circuit, audio amplifier circuit, digital tube circuit and LCD1602 liquid crystal display circuit. The system has doorbell module and electronic clock module. The doorbell module has the function of selecting music, playing and pausing, and the electronic clock module has the function of setting and modifying time.

Keywords:AT89C51, music doorbell, clock, LCD display

ABSTRACT

With the advancement and development of the times, intelligent control, miniaturization of instruments, and miniaturization of power consumption have received extensive attention. In these fields, the single-chip microcomputer has played a pivotal role, which has promoted the application of the single- chip microcomputer to an important position, and the design of the single-chip microcomputer application system has become a new technology hotspot.

As a more important information communication tool in people's daily life, the doorbell was initially set to remind the owner of the visitor by ringing, instead of shouting outside the door. The function is becoming more and more perfect, from a single tone to beautiful music , from a small button to a visual panel, adding the function of the clock, while perfectly solving the singleness of the traditional doorbell, it also increases User experience.

This design takes the ATC89C51 microcontroller as the core, and mainly uses interrupt programming. The system includes a clock circuit, a reset circuit, an audio amplifier circuit, a digital tube circuit and an LCD1602 liquid crystal display circuit. The system has a doorbell module and an electronic clock module. Features.

Keywords:AT89C51, music doorbell, clock, LCD display

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Chapter 1 Introduction

1.1 Background and significance of the research

With the popularization of computers and the greatly increased demand for intelligent electrical appliances in people's daily lives, single-chip microcomputers have become an indispensable part of our daily lives, which is specifically reflected in daily life, the production of various products needed for human life, and the education and learning of students. Therefore, the importance of single-chip microcomputers is self-evident. In our lives, more and more products derived from single-chip microcomputers are developed and produced. For example, single-chip microcomputers can be seen in office equipment and intelligent devices used in office buildings, as well as in many mechanical integration devices in factory buildings. However, if you want to monitor the mechanical operation process in real time and accurately, you must use single-chip microcomputers. At the same time, single-chip microcomputers have also appeared around people's lives: for example, various household appliances used in the home can be integrated with single-chip microcomputers in various devices, making the equipment more automated; the application of single-chip microcomputers in the field of medical equipment; automotive electronics; even in the fields of aerospace systems and national military industry, cutting-edge weapons, etc., single-chip microcomputers are indispensable.

Simulation software for electronic circuit microcontrollers: Proteus is an engineering software launched by a British company. Its function is to simulate the actual process of circuits. It has the core microcontrollers and components used in various microcontroller circuits. Each component can set the size of its unit unit to simulate the microcontroller and external components. Compared with traditional microcontroller physical circuits, the advantages of using Proteus simulation are convenience, simplicity, ability to run multiple times, and avoiding many unnecessary troubles caused by operation and component problems. This also makes Proteus a popular development tool today. Although the current practical application has just begun, it has been widely recognized by many microcontroller enthusiasts, teachers who teach programming, and microcontroller controller R&D and application technicians [1].

This topic is mainly based on the actual application of single-chip microcomputer systems in electronic equipment, and through some specific examples (simulation design and implementation of proteus electronic music doorbell), to introduce the actual application of proteus in single-chip microcomputer systems, which has great practical value in teaching and scientific research.

In today's society, consumer electronic products using digital single-chip microcomputers have long penetrated into various fields of people's daily lives, but it seems difficult to find any application field that lacks the footprint of digital single-chip microcomputers. Now, the application scope of single-chip microcomputer controllers has been quite wide, such as electronic intelligent instruments, digital industrial control, communication devices, automobile guidance control systems, home appliances, etc., and they are all inseparable from single-chip microcomputers. Therefore, the study, research and use of single-chip microcomputers will cultivate engineers and scientific researchers who apply computer technology to intelligent management. The more mature the technology is, the more modern things there are. Mastering single-chip microcomputers is an inevitable requirement of society and a compulsory course in colleges and universities.

1.2 Basis and significance of topic selection

In today's society, consumer electronic products using digital single-chip microcomputers have already penetrated into all areas of people's daily lives. The application range of single-chip microcomputer controllers is quite wide, such as electronic intelligent instruments, digital industrial control, communication devices, automobile guidance control systems, home appliances, etc., and they are all inseparable from single-chip microcomputers. Therefore, the study, research and use of single-chip microcomputers will cultivate engineers and scientific researchers who apply computer technology to intelligent management. The more mature the technology is, the more modern things there are. Mastering single-chip microcomputers is an inevitable requirement of society and a compulsory course in colleges and universities.

Learning MCU is not as easy as it seems. There are many design boards and simulators, which make beginners idle. It does not require much investment to learn MCU well. It is best to spend less money and do more. By programming MCU, from online simulation to various function realization, the purpose is to enable students to

combine the knowledge learned in the course with practice, increase their understanding of MCU, master the use of professional software, understand the product manufacturing process, and thus learn a technology and improve their mastery of knowledge. It also increases the students' practical experience and provides an optional direction for students' employment, thereby broadening their employment channels. 1.3 Overall design and ideas of the subject.

1.3 Overall design and ideas of the project

The design mainly uses the AT89C51 single-chip clock and its corresponding operating circuits, including: clock circuit, reset circuit, key circuit, sound controller, amplifier, speaker, and LCD display circuit. The electronic music doorbell system has the following functions: when the system is in use, the LCD screen will prompt: "Please wait for a moment", the digital tube will display the current time, and the system will emit beautiful music when it is operating normally. At the same time, you can choose to play and pause the current music. There are 5 songs prepared in the doorbell system. While playing the music, the digital tube will display the current time in the format of hours, minutes, and seconds. The user can change the current hour and minute. This system mainly uses the core integrated circuit composed of the AT89C51 single-chip microcomputer, the audio amplifier circuit is used to form the sound amplifier circuit, and the 1602LCD and digital tube are used to form the screen display circuit. The system also has a key function, which can freely select the doorbell and set or proofread the time. The purpose of this is to make the entire system not only clear in regulations and strong in functionality, but also easy to use, which greatly improves the quality of the product. Therefore, in order to realize the three basic functions of the electronic music doorbell system, namely, playing music, electronic clock, and LCD display, the circuit needs to have the following parts: a basic circuit composed of the AT89C51 microcontroller and reset circuit [2], clock circuit, plus an LCD display part and a key circuit part. This design uses a 1602 LCD, and the displayed content is the English translation of "Please wait a moment". The specific implementation requires code design to complete. The electronic clock part: needs to display the current specific time, including hours, minutes, and seconds. The key circuit includes the following points: the electronic music part has the function of playing, selecting, and pausing. The initial idea is that by pressing the doorbell button, the set music can be played in a loop. The

electronic clock part has the function of modifying the time, which is specifically reflected in the ability to modify the values in the hour and minute positions, while the values in the second position cannot be modified. Finally, this design is mainly used for simulation operations, so all circuits will be carried out on the Proteus simulation software, that is, the process of hardware simulation to implement the circuit.

1.4 Structure of this paper

Starting from the second chapter, the specific structure and function of each hardware used, the components used in each module, the function and position of each interface of the component, and the circuit connection method are introduced in turn. The third chapter introduces the main functions used and the corresponding codes, as well as the difficulties encountered in this design and their solutions. The fourth chapter displays related results and debugs the entire system. It introduces the compilation environment used, the corresponding usage methods, the circuit connection method, and makes a detailed summary of this design. It also proposes some new ideas for the subsequent design in the process of completing the project.

Chapter 2 Hardware Circuit Design

2.1 Overall design idea

This design work mainly includes two parts, hardware circuit simulation and system computer program. This chapter will specifically introduce the circuit principles of each module and the construction of the circuit. The system functions are as follows: First, the user will enter the electronic doorbell system. When the doorbell button is pressed, the correct time will be displayed. When the song sounds, it will be played in the order of the first to the last five songs. When the prepared songs start to run in the electronic doorbell system, the English instructions "Please wait" will first appear on the LCD screen, and the current time will be prompted. If there is no human interruption, the song will be played in a loop. When the song play button or the stop button is pressed at this time, the time corresponding to the current song will be paused. Each time the song selection button is pressed, it will automatically switch to the next song. If the fifth song is playing, it will jump to the first song. For the buttons of the electronic clock, the system defaults to modifying the value at the time position. Press the "plus one" and "minus one" buttons to operate. When the time setting key is pressed, it jumps to the minute position. The operation is the same as modifying the hour. The electronic music doorbell structure block diagram is shown in Figure 2-1, and the circuit simulation diagram is shown in Figure 2-2:

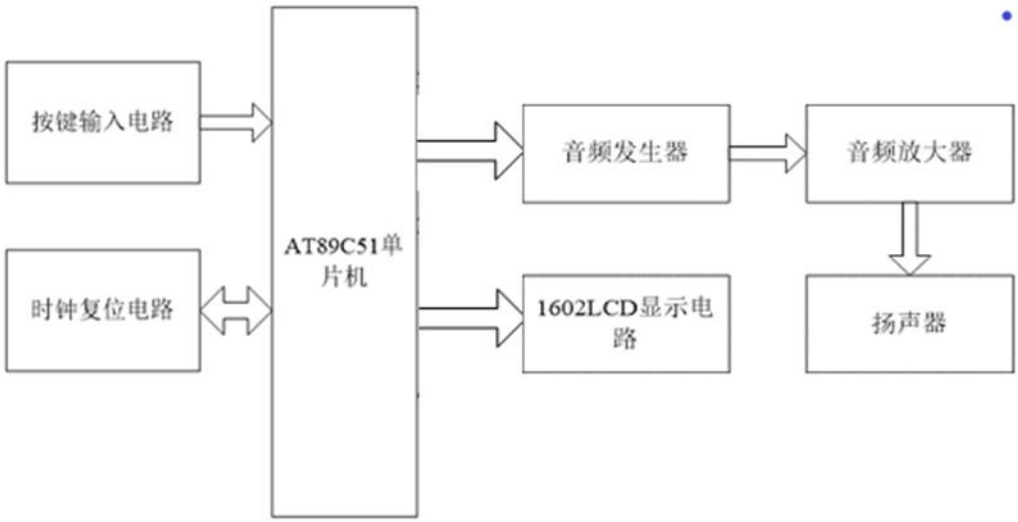

Figure 2-1 Electronic music doorbell structure diagram

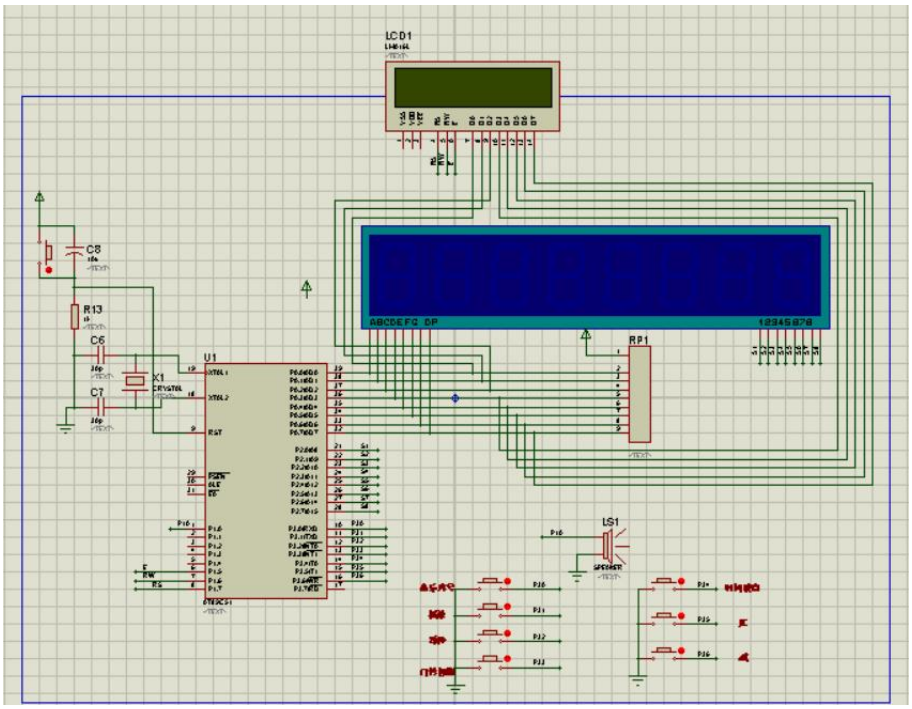

Figure 2-2 Circuit simulation diagram

2.2 Introduction to MCU

The single-chip microcomputer is also called a single-chip microcontroller. It is not only a component to complete a certain performance, but also hopes to realize a complete electronic computer control system on a certain device. Therefore, we can also understand that a single-chip microcomputer is equivalent to a very small electronic computer control system. In short, a single-chip microcomputer can be called a computer in a sense. The advantages of single-chip microcomputers are: extremely small size, light volume, and relatively low price compared to other computers, which makes single-chip microcomputers create a very convenient environment for users in the three fields of teaching, use and research. At the same time, learning to apply single-chip microcomputers is the best way to master the principles of computer composition.

Since the 1990s, the science and technology of single-chip microcomputers has been developing. After continuous progress and development, the science and technology of single-chip microcomputers has been gradually improved and applied to all aspects. Nowadays, the research and application of single-chip microcomputer

technology in intelligent electronic information has been carried out and has received great attention from mankind. The research and development of single-chip microcomputer technology has also entered a new era. Whether it is automatic detection or the application of intelligent instrument tools, traces of single-chip microcomputer science and technology can be found. In the current industrial development process, the electronic product industry is an emerging industry. People in manufacturing have successfully applied electronic product information, combined electronic product information with single-chip microcomputer science and technology, and effectively improved the application efficiency of single-chip microcomputer controllers. Single-chip microcomputers, as a branch of computer science, have been widely used in the field of electronics, adding more comprehensive and advanced performance, and also bringing new fields to the research and application of intelligent electronics, thus realizing the innovation and expansion of intelligent electronics [3].

A single-chip microcomputer is a collection of integrated circuit controller chips. In a single-chip microcomputer, it is generally composed of a CPU, a read-only memory ROM, and a random register RAM. A variety of information collection and control methods can enable the single-chip microcomputer to perform various complex calculations, whether it is to control calculation symbols or to calculate commands for the system. It can be seen that single-chip microcomputers have been fully used in modern intelligent computers with their super information processing technology and computing power. To put it more simply, a single-chip microcomputer is a chip, and a single-chip microcomputer is equivalent to a chip, which constitutes a whole. With the widespread use of integrated circuit technology, the information calculation and processing functions are integrated on the chip, thereby completing the high-speed processing of information.

2.2.1 Introduction to the core chip AT89C51

The main chip used in this design is AT89C51. The following will give a detailed description of its various parts, including: the main CPU, timer, serial port, internal data register, terminal controller, interrupt system and clock reset circuit, etc. As shown in Figure 2-3:

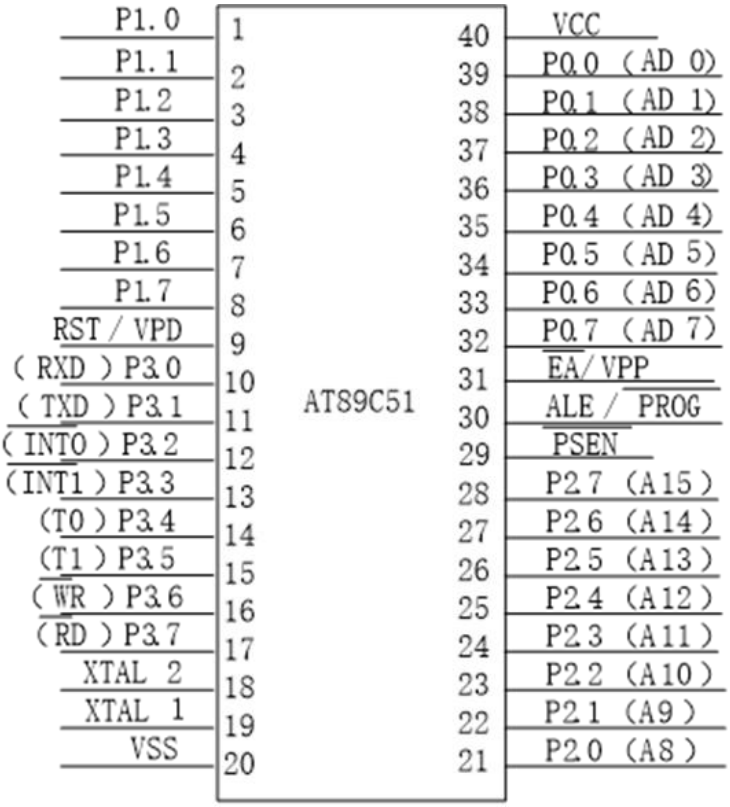

Figure 2-3 AT89C51 microcontroller pin diagram

The AT89 series of microcontrollers have Flash memory, so it is relatively convenient for developers. There are many main models, such as C51, C52, C2051, S51, etc. At the same time, the static clock can also reduce the functional consumption of the corresponding product, which is more environmentally friendly than the same type of microcontrollers.

Main features: In addition to compatibility and some fixed cycle frequency requirements, the microcontroller used this time has multi-level application of memory and related project locking, so that developers can compile input and output lines, 6 interrupt sources, which can be turned into UART channels. At the same time, when static stable operation is required, a relatively low power consumption mode can also be turned on [4].

2.3 Memory Allocation

The memory allocation is shown in Figure 2-4:

Figure 2-4: Initial distribution of internal data

2.4 Reset circuit and clock circuit

2.4.1 Reset Circuit

The main function of the reset circuit is to return the integrated circuit to its original state. The basic principle of restoring the integrated circuit is almost the same as that of a computer. The only difference is the difference in the startup method and means. Restoring the integrated circuit can return the integrated circuit to its original initial state, just like the reset button in a computer. Its main function is to return to the initial state and perform calculations.

The reset circuit can monitor the reset status of the CPU at the same time as power-on and reset: the CPU is always in the reset state, instead of starting the function immediately after power-on and reset. This can prevent the CPU from generating erroneous instructions and performing erroneous operations, and can also greatly improve electromagnetic compatibility.

No matter which type of microcontroller the user chooses, they must pay attention to the design of the microcontroller reset integrated circuit. The quality of the microcontroller reset circuit product design also affects the actual working safety of the entire control system, and the reset circuit becomes a very critical component, so it is recommended to choose products produced by regular companies.

Reset refers to the initialization action implemented by the microcontroller. It mainly changes the PC to zero H, so that the system can start the executable program from the unit of zero H. In addition to the normal system initialization work of the operating system, if the operating system is in a deadlock state due to an error in the program running mode or an error in the operating system, in order to get out of this dilemma, you must first press the reset button or start over. Therefore, the role of the reset circuit is self-evident. If the corresponding reset circuit is missing in the actual hardware circuit or the simulated circuit, in the event of a system crash or user error, the hardware circuit will be damaged and the system will not be able to restart again. Therefore, the reset circuit is indispensable in the circuit construction [5].

After the oscillator is activated, the RST interface is adjusted to a high level of at least two machine times, that is, 24 oscillator times for the 12-minute model and 12 oscillator times for the 6-minute model, and reset is performed. To ensure the reliability of the reset of Shanghai Electric College, the duration of RST maintaining high current must be the oscillator time, which is generally a few microseconds or plus two periodic resets. The temperature sensor adopts the 12-clock mode, except when it is set to a six-minute state in the parallel application.

When the MCU is at a high level, the system will reset the program counter PC and registers with specific functions, such as the information given in Table 2-1. If a high level is given to the RESET interface, it can be restored and cycled. During the period of recovery, ALE and PSEN will be in a high-level working state. The register status after reset is shown in Table 2-1:

Table 2-1 Register status after reset

register	Reset state	register	Reset state
PC	0000H	TMOD	00H
ACC	00H	TCON	00H
B	00H	TL0	00H
PSW	00H	TH0	00H
SP	07H	TL1	00H
DPTR	0000H	TH1	00H
P0-P3	0FFH	SCON	00H
IP	××000000B	SBUF	indefinite
IE	0×000000	PCON	0×××0000

The reset circuit designed this time is shown in Figure 2-5

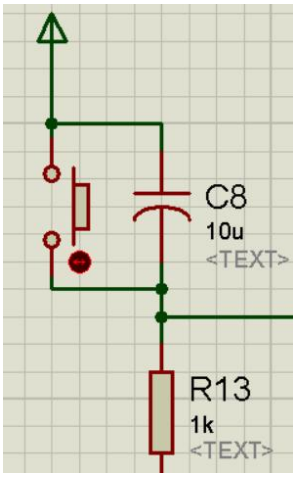

Figure 2-5 Reset circuit simulation diagram

2.4.2 Clock Circuit

The clock circuit is an oscillating circuit that enables the microcontroller to form an accurate movement like a timepiece. All working information is generated according to the date sequence of the clock, and the integrated circuit used to form this timing is the clock integrated circuit. The basic components of the clock circuit include: crystal oscillator device, crystal oscillator suppression chip and its capacitor, but at the same time, the use of clock integrated circuits is very common, such as: the clock circuit of the calculator, the large clock integrated circuit of the electronic watch, and the clock integrated circuit of MP3 and MP4. Basically, any digital control system, when processing and analyzing information, is completed step by step according to the beat, and all components of the control system are also made according to this beat. Therefore, in order to integrate all components of the entire integrated circuit into a certain beat, a kind of "time information" must be formed, and the integrated circuit that generates this time information is also the time integrated circuit. The clock circuit is indispensable in the design of the microcontroller. It is related to whether the circuit composed of the microcontroller system can operate normally and stably. Like the reset circuit, if there is no reset circuit, the system cannot be reset. Similarly, the function of the clock circuit is to enable the system to operate accurately, so both are indispensable.

The clock circuit generates the clock information necessary for the single-chip microcomputer to complete simultaneous operation, and the single-chip microcomputer itself is a very complicated circuit work of the same time. To ensure the completion of the synchronous operation function, the circuit work must be strictly completed in

sequence under the restriction of the only clock information. The time theory studies the relationship between the mutual time of each instruction in the command operation. The specific circuit is shown in Figure 2-6:

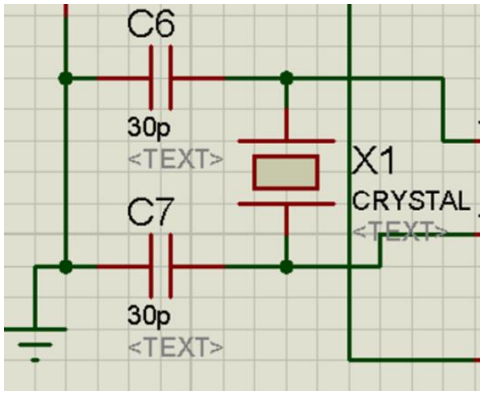

Figure 2-6 Clock circuit design

When choosing an oscillator crystal, the range is usually between 1.2 MHz and 12 MHz. In the actual circuit construction, the capacitor size in the circuit can be selected at will. However, no matter how you choose, there will be some uncontrollable factors that affect the oscillation frequency and the corresponding frequency spectrum, and whether the circuit can work normally. For example, CX1 and CX2 are generally between 20 pF and 100 pF. When the value is between 60 pF and 70 pF, the oscillator will produce a greater high-frequency stability. In this design, the size of the crystal oscillator is 12 MHz, and the capacitance of capacitors C6 and C7 is 30pf.

2.4.3 Working Principle of Clock Circuit

The working principle of the clock system is generally to connect a temperature sensor to the outermost part of the single-chip microcomputer controller (it can also be connected to an internal oscillator) to divide the high-frequency pulse to form the time information inside the single-chip microcomputer controller, which becomes the control information for the coordinated operation of various parts in the chip. The working principle is to use the integrated circuit to cooperate with the external crystal to form the working time inside the single-chip microcomputer controller. Therefore, the clock signal can be caused by two ways: one is through the internal way, through the oscillation circuit inside the chip, to cause the clock signal. The other is through the external way, the clock signal is transmitted from the outside world. Therefore, as long as the single-chip microcomputer cannot control the clock circuit, it cannot work [6].

2.5 Display Circuit Design

2.5.1 LCD display principles and classification

The LCD screen mainly utilizes the physical characteristics of liquid crystal and uses external current to control the indication range, which can display characters and images. LCD screens are thin, suitable for direct drive by large embedded integrated circuits, and easy to achieve full color display effects. They are widely used in applications such as laptops, digital cameras, and PDA mobile communication devices. The LCD screen is only used as a simple visual layout in this design. It displays the English words "Please wait a moment" through two lines of characters to remind visitors to wait a moment. More operations on the LCD screen, such as beautification and adding more content, will be used in future studies.

There are many types of LCDs. If classified by display method, the main models are: single or multiple character type, dot matrix type composed of dots and lines. In addition to the normal black and white screen, LCDs also have color, which can be adjusted through grayscale and color display. If classified by the driver method, there are static drive and simple matrix drive [7].

LCD1602 usually has a buffer inside for displaying characters, so how to display is to write the characters that the developer needs to display on the LCD screen into the RAM. The above functions can be achieved through the ASCII code library or the user-defined text library. However, since the LCD1602 display used in this design has only 32-bit addresses valid, it can only display two rows of characters under normal circumstances, so it is necessary to find the corresponding address. For specific implementation, please refer to the code of the LCD display part in Chapter 3.

2.5.2 LCD1602 Introduction

In addition to displaying single numbers or dots, liquid crystal displays can also display characters. There are many corresponding LCDs on the market. According to the size, the number of characters in each row and the number of rows and columns, they can be divided into many types of LCD screens. The specific objects are shown in Figure 2-7.

Figure 2-7 1602 physical picture

The LCD1602 pin function table is shown in Table 2-2:

Table 2-2 1602LCD pin function table

serial number	symbol	Pin Description	serial number	symbol	Pin Description
1	VSS	Power Ground	9	D2	data
2	VDD	Positive power supply	10	D3	data
3	V L	LCD Bias	11	D4	data
4	RS	Data\Command Selection	12	D5	data
5	R/W	Read/Write Selection	13	D6	data
6	E	Enable signal	14	D7	data
7	D0	data	15	BLA	Backlight positive electrode
8	D1	data	16	BLK	Backlight negative electrode

Each interface of the LCD display used in this design and its corresponding functions are shown in Table 2-2

The first pin is VSS, which is mainly connected to the power ground.

The second pin is VDD, which is usually a +5V power supply.

The third pin is usually used for debugging comparison. There are two situations when the port is connected to the power supply: connecting to the positive pole means the contrast is weak, but after the connection, the comparison degree is the largest. If the

contrast is too high, it is easy to form a ghost image. In the actual circuit, a resistor with a resistance of about 10k is generally selected to adjust

The first three pins from 4 to 6 are control ports, including the type of data to be written, the command line selection of the data, and which port is used to control the enable signal. The details are explained below. Interfaces 7 to 14 are generally used as data ports for mutual input and output, while ports 15 and 16 are special. They are generally used to adjust the positive and negative of the backlight source and are only found in real objects. Next is the relationship between the display address and the actual display position: the address of the first row and the first column is 00, and the address of the first row and the first column is 40. The address here is the normal display address after adding our own starting address. The original address is 0x80, so at this time 0x80 plus 00 is displayed in the current first row and first column. And so on [8].

D0~D7 are 8-bit bidirectional data lines. Next, the instruction instructions and timing of 1602 LCD will be described in detail.

The timing is shown in Table 2-3.

Table 2-3 Basic timing table

Read Status	enter	RS=L、R/W=H、E=H	Output	D0~D7=status word
Write instruction	enter	RS=L, R/W=L, D0~D7=instruction code, E = High Pulse	Output	none
Read Data	enter	RS=H、R/W=H、E=H	Output	D0~D7=Data
Writing Data	enter	RS=H、R/W=L、 D0~D7=data, E = High Pulse	Output	none

Finally, the function of the LCD1602 liquid crystal display circuit: the main function of the LCD display is to display a prompt. When a guest comes to visit, he presses the doorbell button and the display will show the polite phrase "please wait a moment", which is translated into English as "please wait a moment". The purpose is to let the visitor wait for a moment, realizing the function of an LCD display.

2.6 Digital tube display

2.6.1 Structure and principle of digital tube

The interior of the digital tube is actually composed of 8 LEDs, but the 8 LEDs are arranged in an eight-shaped shape. The display effect between each segment in the eight-shaped shape can be adjusted by whether the LED light is turned on or off. Since it is composed of LEDs, there must be two connection methods: common cathode and common anode. One is common yin and yang: the common cathode connection rule is to connect the positive and negative poles of the entire LED together, the COM port is directly grounded, and the a to dp ports are connected to the I/O port of the microcontroller. The common anode connection rule is to connect the anode of the entire LED, and connect a high level from the COM port, such as a power supply. The a to dp interface is still directly connected to the I/O interface of the microcontroller. For the common cathode connection method, the high level is valid, and the LED will only light up after the high level. The common anode connection rule is valid at a low level, that is, the LED will light up after the microcontroller gives it a zero [9].

The specific display characters and the corresponding segment code table for common anode or common cathode connection are shown in Table 2-4:

Table 2-4 Display characters and corresponding common anode (common cathode) connection segment code table

show character	Common cathode Field Code	Common Anode Field Code	show character	Common cathode Field Code	Common Anode Field Code
0	3FH	C0H	C	39H	C6H
1	06H	F9H	D	5E	A1H
2	5BH	A4H	E	79H	86H
3	4F	B0H	F	71H	8E

4	66H	99H	P	73H	8CH
5	6DH	92H	U	3E	C1H
6	7DH	82H	T	31H	CEH
7	07H	F8H	Y	6E	91H
8	7F	80H	L	38H	C7H
9	6FH	90H	8.	FFH	00H
A	77H	88H	"Destructio n"	00	FFH
B	7CH	83H	…	…	…

2.6.2 Digital tube display methods - static display and dynamic display

The static display features mainly include the following: the vertical connection of the common port (common cathode) or the power supply (common anode), the segment selection line of each digital tube is connected to an i/o wiring port, and the display is always on each digital tube. As shown in Figure 2-8:

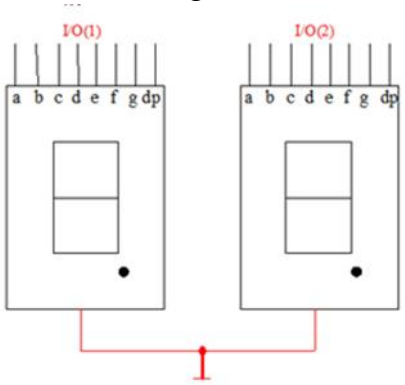

Figure 2-8 Digital tube static display

The second representation method is dynamic display. The electronic clock module of this design uses this method to represent time. It has a characteristic advantage: the segment selection line of each digital tube is connected in series by an I/O connection

line, and the common port of each digital tube is controlled by an I/O line, which is displayed one by one.

Dynamic display is divided into two lines, segment code line and bit code line. Segment code line corresponds to the interface line of abcdefgdp, and bit code line corresponds to which bit is displayed. This will cause a problem. Dynamic display can only display one number at a time, but in fact it is not like this, because there is a phenomenon of visual persistence. When the display frequency is too fast, the human eye cannot observe the current position disappearing, thus achieving the display effect [11]. As shown in Figure 2-9:

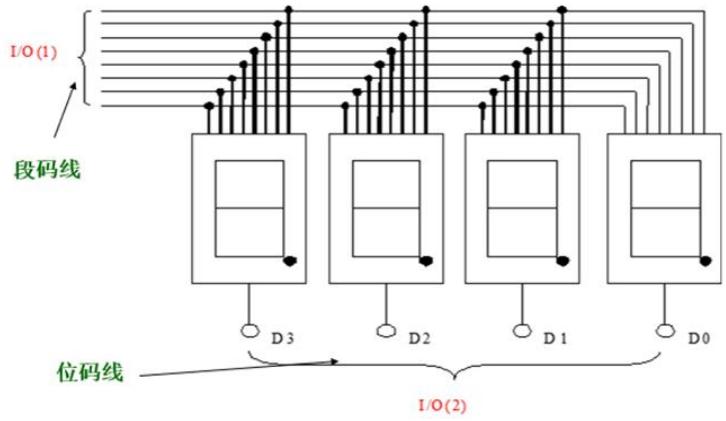

Figure 2-9 Dynamic display of digital tube

There are two types of dynamic display lines, segment code lines and bit code lines. The segment code lines correspond to the interface lines of abcdefgdp, and the bit code lines correspond to which bit is displayed. This will cause a problem. The dynamic display can only display one number at a time, but in fact it is not like this, because there is a phenomenon of visual persistence. When the display frequency is too fast, the human eye cannot observe the current position disappearing, thus achieving the display effect.

The specific simulation circuit diagram of the digital tube is shown in Figure 2-10:

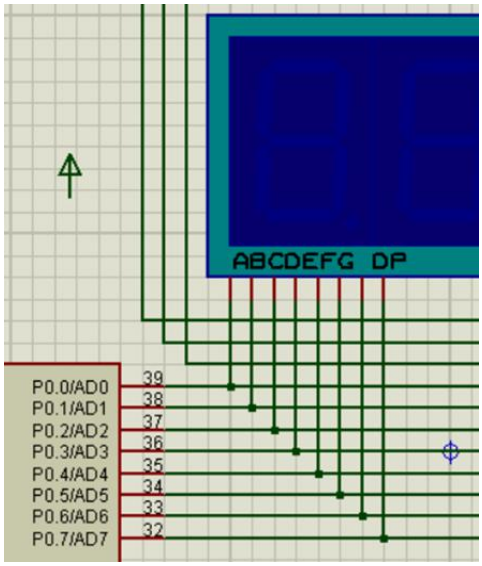

Figure 2-10 Partial diagram of digital tube simulation circuit

2.7 Key Circuit Design

2.7.1 Basic principles of keyboard

Use a pull-up resistor to connect the system I/O port, and then use a key to connect. When the system's I/O port detects a low level that is valid, it will prove that the key is pressed. When it is disconnected, it is a high level, and when it is closed, it is a low level that is valid.

2.7.2 Jitter Elimination

When the keyboard is pressed again, the hand will vibrate, so the keyboard will produce a vibration similar to a burr. The way to eliminate jitter is: Since the vibration has a long duration, about ten to twenty milliseconds, the vibration can be eliminated by delaying for ten or twenty milliseconds at the beginning. Then test the input or output level at this time. If it is still a low level, it is more effective. Then it can be determined that the keyboard is still in the stage of being pressed again. There are two main ways to eliminate jitter: one is hardware de-jittering, and the other is software system de-jittering. Hardware de-jittering technology uses a storage-like method to eliminate jitter by delaying, while software de-jittering uses a delay program to eliminate jitter [12].

In this design, the doorbell module of the electronic music doorbell system has the functions of playing, selecting music, and pausing. The clock module has the functions

of setting time, adding and subtracting the value of the hour position, and adding and subtracting the value of the second position. The following is a diagram of the specific simulation circuit. The key circuit of the digital tube is shown in Figure 2-11, and the simulation circuit of music playback is shown in Figure 2-12

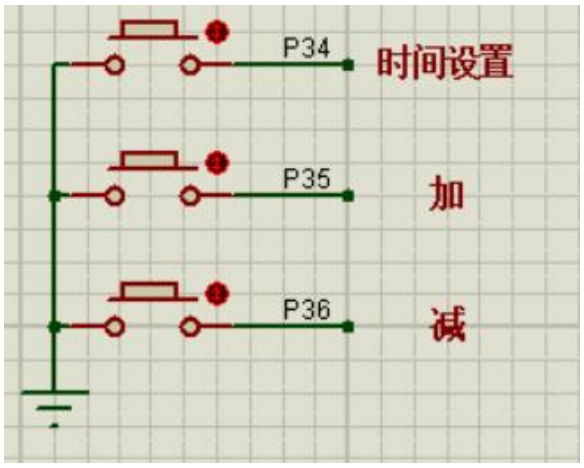

Figure 2-11 Electronic clock module key simulation circuit diagram

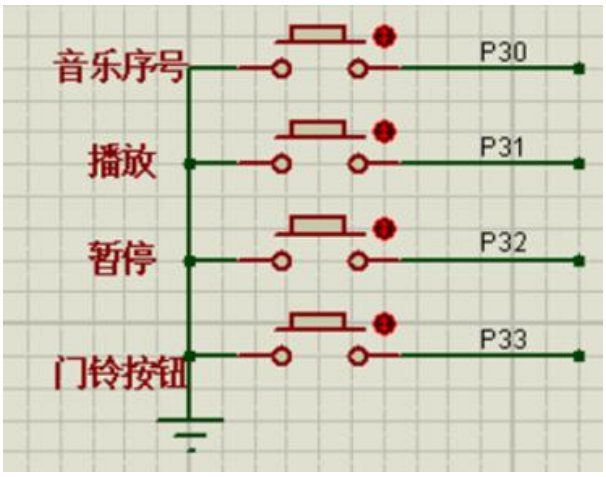

Figure 2-12 Electronic music doorbell module button simulation circuit diagram

2.8 Timer

2.8.1 Timer/Counter Mode Register TMOD

The timer in register TMOD is divided into four digits: GATE, C/T, M1, and M0 (from high to low). The first four high bits control timer 1, and the last four low bits control timer zero. The first two bits of M1 and M0 are the working selection positions, which can be used to select the four modes of T0 and the three modes of T1. In the

selection case, one of them is more commonly used, which is a 16-bit periodic/counter. Working method 2 is an eight-bit manual reset timer/counter. Since the baud rate related to serial communication is mainly used, the timer counter usually adopts working method 1. This working method will be introduced in detail later. C/T position: The position is selected by the timing technical method. When C/T=1, it works in the counting method: When C/T=0, it works in the timing method. GATE position: Gate limit position, used to limit whether the start of the timer/meter can be directly affected by external interrupts or request information. It is generally set to 0. If the timer is started by an external interrupt, the GATE position can be set to 1 [13].

2.8.2 Timer/Timer Control Register TCON

Among them: TR0(1): The overflow flag position of the periodic/counter T0(1). When the periodic/counter T1 counts up, it is reset by hardware. Once the interrupt is enabled, the T1 interrupt is issued. After entering the pause management state, it is automatically eliminated by the internal hardware circuit. Taking the 13-bit timer as an example, the upper limit is 2^13-1, but if it is a 16-bit timer, the upper limit is also 2^16-1. It starts when TR0(1) is 1 and stops when it is 0. IT0(IT1): Controls the external interrupt trigger. When IT0 (or IT1) is set to zero, it is level triggered. When IT0 (or IT1) is set to 1, it is edge triggered. IE0(IE1) is the interrupt request flag that controls external interrupt 0 (or 1).

2.8.3 How the Timer/Counter Works

There are two working modes, mode 0 and mode 1. Different timing counters correspond to different working modes. The relationship between the specific count value and the initial value is as follows:

Mode 0: 13-bit timer/counter mode

The relationship between the count value N and the initial value X is: X=2^13-N/(12/fosc)

Mode 1: 16-bit timer/counter mode

The relationship between the count value N and the initial value X is: X=2^16-N/(12/fosc)

In the above two methods, after the last calculation, the counter value is zero. If you want to calculate again, you must reset the original value. The unit is: us, fosc

represents the crystal frequency, which is generally 12MHz or 11.059MHz in 51 single-chip microcomputers.

2.9 Principles of Electronic Music Performance

The frequency value (pitch) of the various notes that make up the music and the length of time the notes last (duration) are two basic data that determine whether the music can be played smoothly. Therefore, if the strength and duration of the excitation signal transmitted to the speaker can be adjusted, the speaker can produce a continuous, stable and correct musical timbre.

2.9.1 Tone Control

Each piece of music is composed of different vowels. There are seven different note names in total, which are: do, re, mi, fa, so, la, hi. The formation of sound is mainly due to the vibration of air, and each note name has a relatively stable air vibration frequency, and this vibration frequency determines the pitch of the sound. The spectrum information of each tone can be obtained by querying the data, which will not be explained in detail here. Therefore, as long as the circuit is used to generate the corresponding spectrum information to drive the buzzer of the speaker, the corresponding sound can be generated. Therefore, the timer can be used to generate the corresponding spectrum information, so as to produce different timbres by driving the speaker.

2.9.2 Control of tone length

The notes in music not only have the strength of the tone, but also the length of the sound. Some notes need to be sung for a quarter beat, some for two beats, etc. In the music score, if there is no short line under the x, it is a quarter note, a short line in the middle represents a sixteenth note, and a short line on the right side of the x represents a half note.

Rhythm control can be controlled by the number of times the delay subroutine is called. Assuming a rhythm of 520 milliseconds per beat, one beat requires the delay subroutine to be called four times in a loop. Similarly, half a beat requires the delay subroutine to be called twice.

This chapter introduces the specific models of components used in each circuit module of the electronic music doorbell system, the operations corresponding to each interface and the specifications of related codes.

2.10 Chapter Summary

This chapter mainly introduces the detailed introduction of various hardware used in this electronic music doorbell and the writing of corresponding codes. It also introduces the functions of the main module of electronic music and the specific process of how to realize music playback.

Chapter 3 Software Design

3.1 Main program design

The main program completes the initialization of the LCD1602 liquid crystal display, the clock part displays, and the scanning key work. The operation flow chart of the main program is shown in Figure 3-1

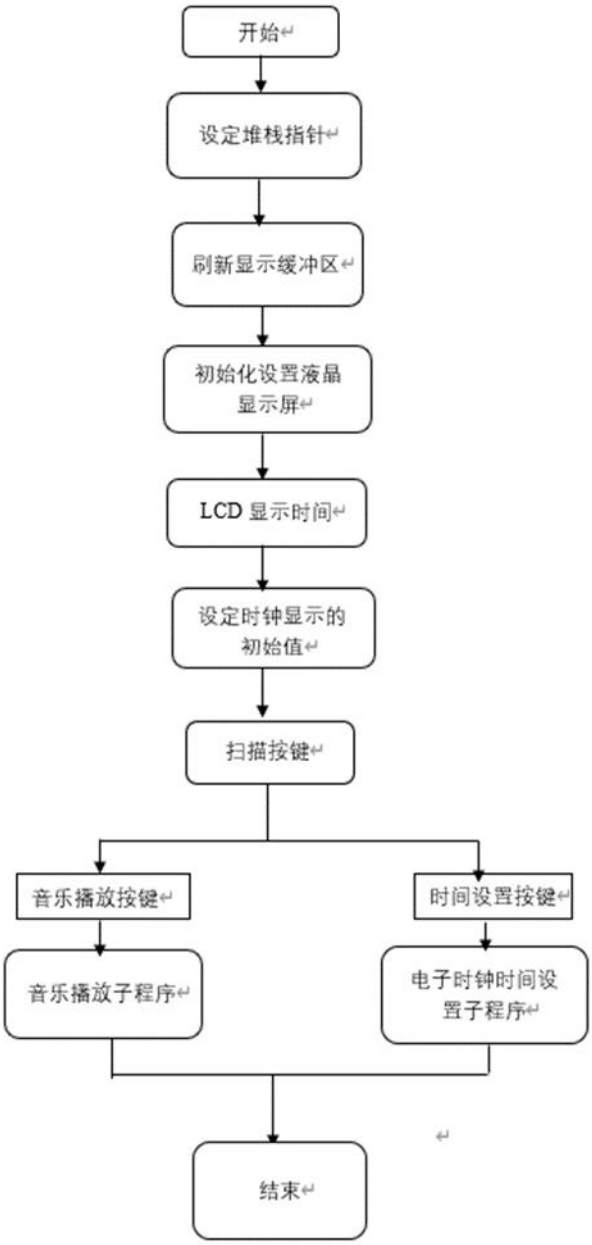

Figure 3-1 Overall flow chart

After the system completes the initialization of the electronic clock and LCD display, it scans whether any button is pressed. If the doorbell button is pressed, it enters the music playback subroutine and starts playing music in a loop. If the time setting button is pressed, it enters the electronic clock subroutine to set the time.

3.2 LCD display subroutine

The LCD display program uses LCD1602, so you need to know the corresponding instructions as follows:

0x38: Mainly initialize the settings, set the display size and data interface

0x0C: Set to display, but not to display the cursor

0x06: After writing a character, the address pointer increases by one

0x01: Display cleared, data pointer cleared

0x80: The starting address of the first line of LCD

0x80+0x40: The starting address of the second line of LCD

The first is the declaration: LCD data and command selection interface need to be declared. Sbit can be used to define the bit variable of the special function register, that is, the interface = the number of the P (x) port. The main purpose is to operate the bit variable.

Next is the read-write control, defining the RW port as the sixth bit of the P1 port. Finally, the enable signal port also requires a specific declaration [15]. The specific code is as follows:

Next is the content displayed on the LCD screen, which is "Please wait a moment" in English. Since the LCD screen cannot display all the information in one line, two strings need to be defined for input. First, set the RS, RW, and EN ports to low levels. The specific flow chart is shown in Figure 3-2:

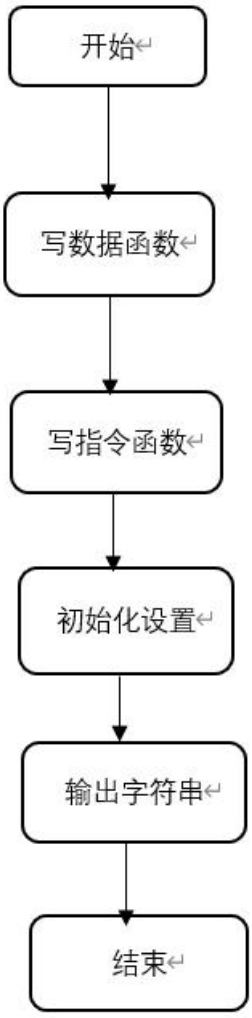

Figure 3-2 LCD1602 liquid crystal display flow chart

The simulation circuit diagram is shown in Figure 3-3:

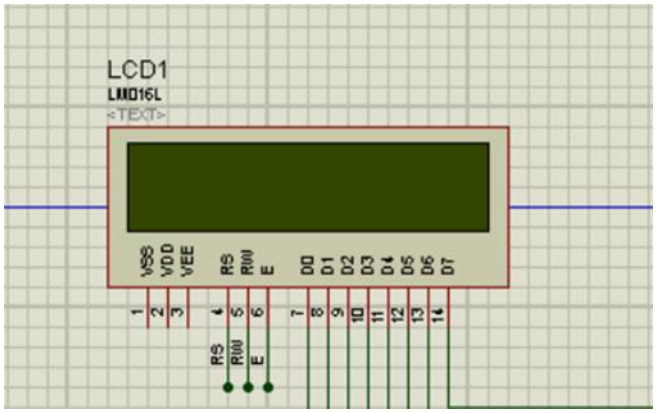

Figure 3-3 LCD1602 liquid crystal display simulation circuit diagram

The running results are shown in Figure 3-4:

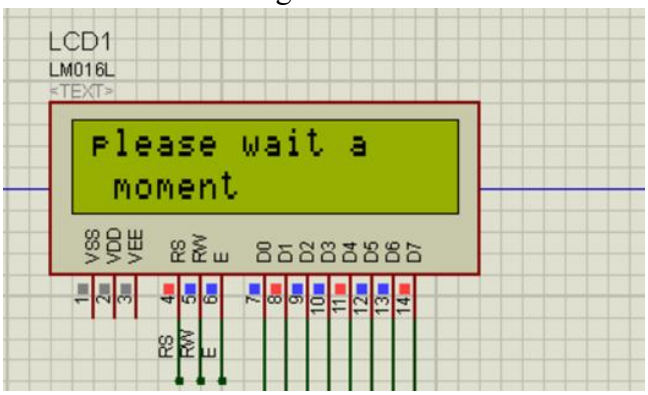

Figure 3-4 LCD1602 liquid crystal display operation results

The specific codes are shown in Table 3-1

Table 3-1 Some codes of LCD display

```
void wr_com(uchar com)//write instruction//
{
First, by delaying 1 millisecond
RS, RW, EN ports are all set to low level
Put the command value to be written on port P0
Then delay for 1 millisecond
EN=1; Write command through falling edge
delay1ms(1); //delay 1 millisecond
Finally, set the enable terminal to 0
}
void lcd_init() // Initialization settings
{ delay1ms(15);
wr_com(0x38);delay1ms(5); // Character size is 5*7
wr_com(0x08);delay1ms(5); // cursor
wr_com(0x01);delay1ms(5);// clear screen
wr_com(0x06);delay1ms(5);// Character automatically increases by one
wr_com(0x0c);delay1ms(5); // Cursor settings
}
uchar Disp[]="please wait a "; //The first line displays: please wait a
uchar Disp1[]=" moment "; //The second line displays moment
```

In the main function, the string Disp is displayed on the first line of the LCD screen through a loop, and then positioned to the second line through wr_(0x80), so that the characters of the string Disp1 are displayed on the second line.

The main button settings of the key circuit:

```
//#define sound_amount 5 //Number of songs
sbit play_up=P3^0;          //Previous song
sbit play_down=P3^1; //Next song
sbit pause=P3^2; //play\pause
sbit power=P3^3; //Power on/off
sbit speaker=P1^0; //passive buzzer
sbit k1=P3^4; //Time setting
sbit k2=P3^5; //Current time unit plus one
sbit k3=P3^6; //Current time unit minus one
```

3.3 Electronic clock buttons

The clock buttons are mainly divided into time settings, current time unit plus one, current time unit value minus one, then take minute and hour plus one as an example, first judge the time through the if function, perform the current second + 1 operation, if the second position value is greater than 59 at this time, then the hour position value + 1, if the minute position value is greater than 59 at this time, then the hour position value plus one, and so on, the button part code is shown in Figure 3-5, the specific code is shown in Table 3-2:

```
sbit k1=P3^4;        //时间设置
sbit k2=P3^5;        //加
sbit k3=P3^6;       //减
```

Figure 3-5 Partial key module code

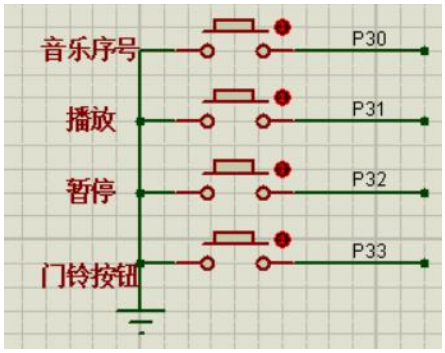

Figure 3-6 Electronic clock button part

Table 3-2 Partial code display of LCD display

```
if(!k2) //Time setting value plus 1
delayms(5);
First, is k2 pressed?
if(set_n==1) //If the corresponding setting N value is 1, then the time setting is in the hour position
hour++; //Add one to the value at the current time position
if(hour>23) //Judge whether the time value is greater than 23
hour=0; //If it is greater than 23, the value at the time position is cleared
}
else if(set_n==2) //The time setting is in the minute position
min++; //Add one to the current minute position
if(min>59) //Judge if the minute value is greater than 59
min=0; //If it is greater than 59, the value of the time position is cleared
}
Finally, consider what to do when you hold down the pause button
if(!k2) //Time setting value plus 1
delayms(5);
First, is k2 pressed?
if(set_n==1) //If the corresponding setting N value is 1, then the time setting is in the hour position
hour++; //Add one to the value at the current time position
if(hour>23) //Judge whether the time value is greater than 23
hour=0; //If it is greater than 23, the value at the time position is cleared
}
else if(set_n==2) //The time setting is in the minute position
min++; //Add one to the current minute position
if(min>59) //Judge if the minute value is greater than 59
min=0; //If it is greater than 59, the value of the time position is cleared
}
Finally, consider what to do when you hold down the pause button
```

The screenshot of the electronic clock in its initial state is shown in Figure 3-7:

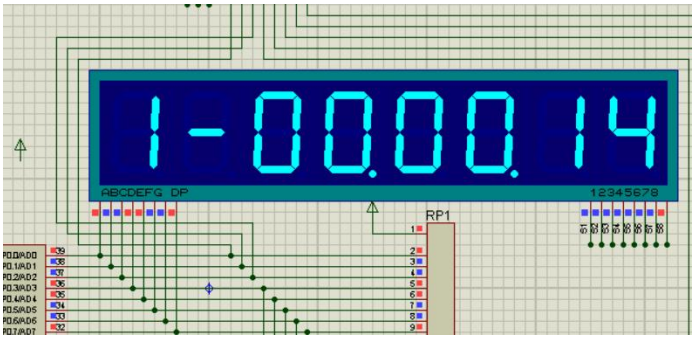

Figure 3-7 Screenshot of the electronic clock running in its initial state

Screenshots of adding one to the hour and minute values of the electronic clock are shown in Figures 3-8 and 3-9:

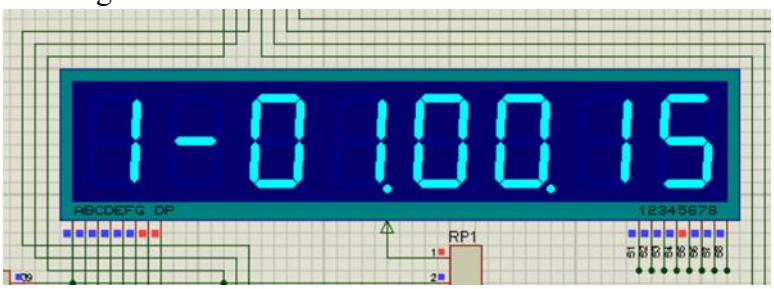

Figure 3-8: Execution of the value increment operation

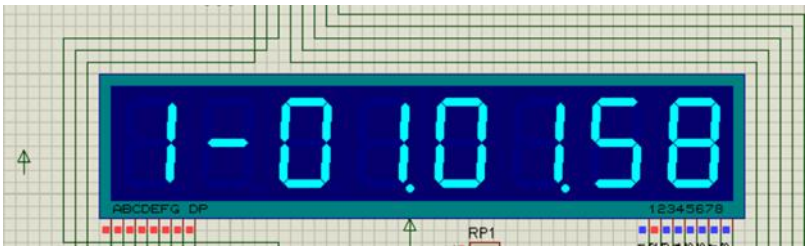

Figure 3-9 Execute the operation of adding one to the minute digit

Screenshots of the operation of subtracting 1 from the hour and minute values of the electronic clock are shown in Figures 3-10 and 3-11:

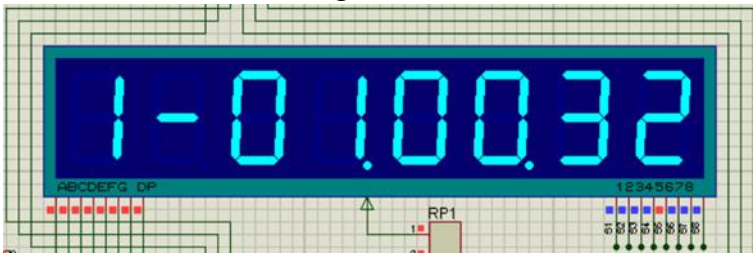

Figure 3-10 The value on the quantile is reduced by one

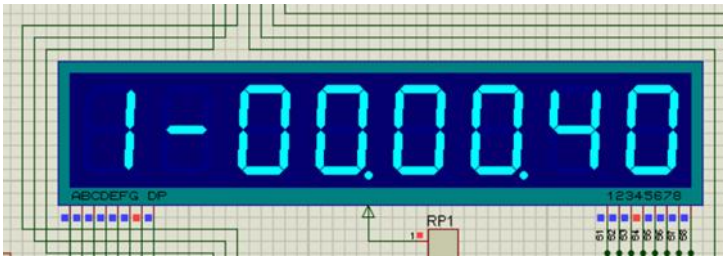

Figure 3-11 The value on the time position decreases by one

In this design, the clock circuit is controlled by timer t1, and the initial reload value is set to 500 microseconds, that is, an interrupt is made every 0.5 milliseconds. The code part is shown in Figure 3-12:

```
void  Time1() interrupt 3
{
  TH1=(65536-500)/256;       //重装初值50ms;
  TL1=(65536-500)%256;
  m=m+1;
  mmm++;
  if(mmm>7)
    mmm=0;
   P0=0XFF;
  switch(mmm)
  {

    case 0:P2=0x80;
   P0=table[sec%10];        //显示秒个位
      break;
    case 1: P2=0x40;
   P0=table[sec/10];       //显示秒十位
      break;
    case 2: P2=0x20;              //显示分个位
```

Figure 3-12 Clock part timer code

The set time is to interrupt once every 0.5 milliseconds. The initial value of the count m is 0. 2000 times is 2000*0.5=1000ms, that is, when 1s is up, the value on the second position is increased by 1. Finally, the base system of the second, minute, and hour positions is determined.

3.4 Electronic Music Buttons

The buttons of the electronic music part mainly include the following: when the system is running, it automatically plays songs in a loop, pauses the current song, plays the next song, and the specific music number will be displayed on the digital tube.

The music will be played in a loop from the first to the fifth song. The specific implementation code is as follows. First, the music pause part is shown in Table 3-3:

Table 3-3 Electronic music key codes

#if 1

```
if(!pause)          //Pause button processing
{
delayms(5);
if(!pause) //When the pause button is pressed
{
TR0=0;              //Timer/Counter T0 overflow flag is set to 1
speaker=1;
play_enable=0;   //Stop playing
}//Pause key processing ends
if(!play_up) //Previous song button
{
delayms(5); delay 5ms
if(!play_up) //Press the music number button to play the next song
{
TR0=0; //Timer T0 overflow flag is set to 1
speaker=1;
music_num++; //Song number plus one
if(music_num>=6) //Judge if the song number is greater than or equal to 6
music_num=1; //Set the number of the currently playing song to 1
num=0;        //Start playing from the beginning
delayms(500); // song switching delay 0.5S
miao=0;
}
```

Taking the playback of the first and second songs as an example, the running screenshots are shown in Figure 3-13 and Figure 3-14:

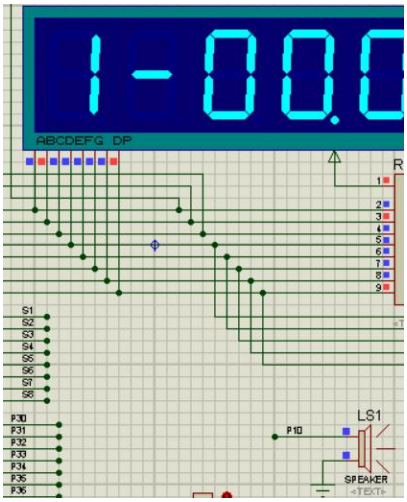

Figure 3-13 Screenshot of the first song playing

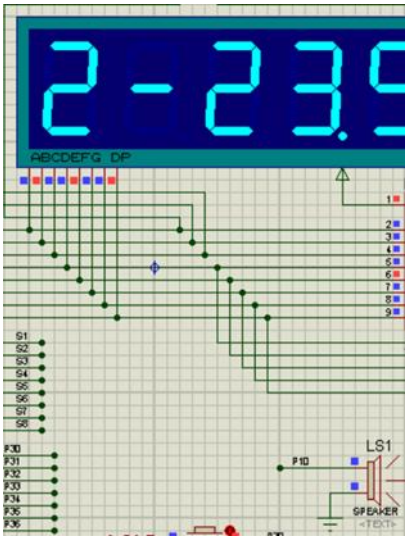

Figure 3-14 Screenshot of the second song playing

3.5 Digital tube display

In this design, the digital tube mainly displays the current time, which consists of three digits: hour, minute, and second. As mentioned in the previous digital tube hardware part, dynamic display of the dynamic digital tube LED digital tube is required. Because in the digital tube, all the segment selection lines of the digital tube are connected in parallel with a group of I/O interface lines, which is exactly the same as the time display effect. At the same time, due to the visual persistence effect of the human eye, when the delay is small enough, we can observe the effect of all numbers

arranged at the same time. The specific code implementation is shown in Table 3-4, taking seconds as an example:

Table 3-4 Digital tube module code

```
Time1() interrupt 3
{
TH1=(65536-500)/256;        //Reload the initial value 500 microseconds;
TL1=(65536-500)%256;
m=m+1; // The value of m is increased by one
mmm++; mmm mainly controls the position of the refreshed digital tube
if(mmm>7)
mmm=0;
P0=0XFF; //All set to high level
switch(mmm)
case 0: P2 = 0x80;
P0=table[sec%10];              // Display the seconds
break;
case 1: P2=0x40;
P0=table[sec/10];              //Display tens of seconds
Timer part:
if(m>=2000)                          // m=2000 means 1 second has expired
{
m=0; //The initial m value is 0
sec++;
if(sec>59)                     //Judge reaching 60s
{
min++;                         //Minute plus 1
sec=0;
if(min>59)                //Judge reaching 60 points
{
hour=hour+1;              //hour plus 1
min=0;
if(hour==24) // Check if the hour value is greater than 60
```

```
{
hour=0; //If it is greater than 60, clear it
```

3.6 Electronic Music Doorbell

The circuit in this design uses a buzzer connected to the P3 port of the AT89C51 microcontroller. When the buzzer is simulated, the sound is placed on the sound card. There are two types of buzzers: one is to make a sound when powered on, and the second requires a pulse signal or a sine wave signal for the buzzer to change. The buzzer used in this graduation design is not a buzzer that sounds when powered on, but a buzzer that sounds when triggered by a square wave. The second solution is through a small speaker driven by a small transistor. Because the I/O port cannot be driven alone, a transistor can be used to drive the speaker to achieve the function of playback. First, let's talk about the idea of implementing the program: first, define a pin p3.0 to drive, and other pins can also be driven. In addition, an array needs to be defined. Each tone of Do-Re-Mi-Fa-Sola-Hi has a fixed frequency. This frequency has a reference basis. This can be done by understanding music theory. I used a timer to do it. What I need to prepare is to calculate the timing value of each frequency to get an array of frequency values. A special keyword code is used, which is to put the array into the read-only memory as a code. Because the memory of the 51 microcontroller, that is, the on-chip memory, is very small, such a large array cannot be directly written into the RAM of the 51 microcontroller, so the code keyword must be added to put the data in the code area and ROM [16]. The audio amplifier circuit is shown in Figure 3-15:

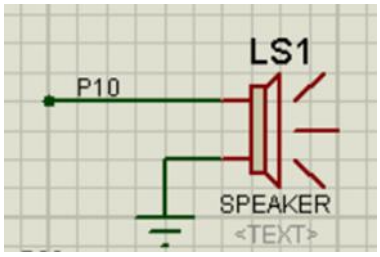

Figure 3-15 Audio amplifier circuit

The main functions that the functions can implement respectively are: the enable flag of music playback, which can be used to perform and pause, the general delay sub-function limits the duration of pronunciation, the general delay sub-process can be used to eliminate jitter, and perform the next note and play the song at the same time.

The play pause function limits the duration of pronunciation through the demonstration sub-function delay, sets each beat to 0.4 seconds, and then through the nested loop, a total of T beats can be delayed. During the nesting period, the T zero interrupt state can be entered to pronounce, and set to TR0=0, thereby achieving the effect of turning off t0 and pausing pronunciation. The timer0interrupt1 function can be used to express the t zero pause program to limit the tone of pronunciation. The following 5 songs are selected for playback: "Fireworks Cool Easily", "Hair Like Snow", "Simple Love", "Only Mother is Good in the World", and "Who Will You Think of If You Are Lonely".

power_enable=0; //The enable bit of the current song playback, which is used to control the song playback and pause

Through the delay function, the music playing system can control the tone and the pronunciation time of the specific current note by controlling the length of the singing time.

void delayms //Delay program. In the key circuit, it is necessary to eliminate jitter to prevent system problems caused by users pressing the key for a long time. When playing music, the delay length is obtained according to the corresponding frequency table to produce sounds of different tones.

void song(void); //Play a note

In order to play music accurately, it is necessary to find the corresponding frequencies of the bass, treble and super treble of each note, as shown below. At the same time, the specific music score selected in the design will be displayed in the attachment. The data table of note pronunciation frequency mainly comes from online blogs. The corresponding bass, treble and super treble are basically accurate.

The music score arrays of the tracks "Fireworks Cool Easily", "Hair Like Snow", "Simple Love", "Only Mother Is Good in the World", and "Who Would You Think of If You Are Lonely" are shown in Figures 3-16, 3-17, 3-18, 3-19, and 3-20 respectively:

```
//《烟花易冷》
unsigned char code song1[]={
      5,2,1, 3,2,1, 2,2,2, 2,2,4, 3,2,1, 1,2,1, 2,2,1, 3,2,4,
   5,2,1, 3,2,1, 2,2,2, 2,2,2, 5,1,1, 3,2,1, 4,2,1, 3,2,4,
   3,2,1, 3,2,1, 7,2,1, 3,2,1, 2,2,2, 1,2,1, 7,1,1, 1,2,1,
   2,2,1, 3,2,1, 6,2,3, 6,1,1, 1,2,1, 3,2,1, 2,2,1, 6,1,1,
   1,2,1, 7,1,1, 5,1,1, 6,1,6, 5,2,1, 3,2,1, 2,2,2, 2,2,1,
   2,2,1, 3,2,1, 1,2,1, 2,2,1, 3,2,4, 5,2,1, 3,2,1, 2,2,2,
   2,2,1, 2,2,1, 5,1,1, 3,2,1, 4,2,1, 3,2,4, 3,2,1, 3,2,1,
   7,2,3, 3,2,1, 2,2,2, 1,2,1, 7,1,1, 1,2,1, 2,2,1, 3,2,1,
   6,2,3, 6,1,1, 1,2,1, 3,2,1, 2,2,1, 6,1,1, 1,2,1, 7,1,2,
   5,1,2, 6,1,6, 0,0,0 };
```

Figure 3-16 Custom array of the music score of "Fireworks Cool Down Easily"

```
//《世上只有妈妈好》
unsigned char code song4[]={
     6,2,3, 5,2,1, 3,2,2, 5,2,2, 1,3,2, 6,2,1,
   //6,2,3代表6,中音,3个半拍;
   //5,2,1代表5,中音,1个半拍;
   //3,2,2代表3,中音,2个半拍;
   //5,2,2代表5,中音,2个半拍;
   //1,3,2代表1,高音,2个半拍;
   //...
     5,2,1,6,2,4, 3,2,2, 5,2,1, 6,2,1, 5,2,2, 3,2,2, 1,2,1,6,1,1, 5,2,1,
   3,2,1, 2,2,4, 2,2,3, 3,2,1, 5,2,2, 5,2,1, 6,2,1, 3,2,2, 2,2,2,
   1,2,4, 5,2,3, 3,2,1,2,2,1, 1,2,1, 6,1,1, 1,2,1, 5,1,6, 0,0,0};
```

Figure 3-17 Custom array of the music score of "Hair Like Snow"

```
//《发如雪》
unsigned char code song2[]={
     5,1,1, 2,2,1, 3,2,2, 2,2,1, 3,2,1, 5,2,1, 6,2,1, 5,2,3, 1,2,1, 2,2,1,
   3,2,1, 6,2,1, 5,2,1, 3,2,1, 5,2,3, 5,2,1, 6,2,1, 1,3,2, 6,2,1, 5,2,1,
   3,2,1, 5,2,1, 3,2,2, 1,2,1, 2,2,1, 3,2,1, 1,2,1, 6,1,1, 3,2,1, 2,2,1,
   5,1,1, 2,2,1, 3,2,2, 2,2,1, 3,2,1, 5,2,1, 6,2,1, 5,2,3, 1,2,1, 2,2,1,
   3,2,1, 6,2,1, 5,2,3, 5,2,1, 6,2,1, 1,3,2, 6,2,1,
   5,2,1, 3,2,1, 5,2,1, 3,2,2, 1,2,1, 6,1,1, 3,2,1, 2,2,1, 1,2,1, 6,1,1,
   1,2,1, 2,2,1, 2,2,1, 1,2,4, 0,0,0 };
```

Figure 3-18 Custom array of music score of "Simple Love"

```
//《简单爱》
unsigned char code song3[]={
     5,1,1, 1,2,1, 2,2,1, 3,2,1, 2,2,1, 3,2,1, 4,2,1, 5,2,1, 5,2,1, 5,2,1,
   4,2,1, 3,2,1, 2,2,3, 5,1,1, 1,2,1, 2,2,1, 3,2,1, 4,2,1, 5,2,1, 5,2,1,
   5,2,1, 6,2,1, 5,2,2, 2,2,1, 3,2,1, 1,2,2, 1,2,1, 6,1,1, 2,2,1, 2,2,1,
   3,2,1, 3,2,1, 1,2,1, 5,2,1, 1,2,1, 5,2,1, 1,2,1, 7,1,1, 1,2,1, 1,2,1, 6,1,1,
   2,2,1, 2,2,1, 3,2,1, 3,2,1, 5,2,1, 5,2,1,
   5,2,1, 6,2,1, 5,2,2, 2,2,1, 3,2,1, 1,2,2,
   5,1,1, 1,2,1, 2,1,2, 3,2,1, 2,2,1, 3,2,1, 4,2,1, 5,2,1, 5,2,1, 5,2,1,
   4,2,1, 3,2,1, 2,2,3, 5,1,1, 1,2,1, 2,2,1, 3,2,1, 2,2,1, 3,2,1, 4,2,1,
   5,2,1, 5,2,1, 5,2,2, 2,2,1, 3,2,1, 1,2,2, 1,2,1, 6,1,1, 2,2,1, 2,2,1,
   3,2,1, 3,2,1, 1,2,2, 5,2,1, 1,2,1, 5,2,1, 5,2,1, 7,1,1, 1,2,1, 0,0,0 };
```

Figure 3-19 Custom array of the music score of "Only Mom is Good in the World"

```
//《当你孤单你会想起谁》
unsigned char code song5[]={
     3,2,2, 3,2,1, 4,2,1, 3,2,2, 2,2,1, 1,2,1,  2,2,2, 5,2,2, 2,2,2, 2,2,3,
   1,2,2, 1,2,1, 2,2,1, 1,2,2, 7,1,1, 6,1,1, 7,1,2, 3,2,2, 7,1,2, 7,1,3,
   6,1,2, 2,2,1, 3,2,1, 2,2,1, 1,2,1, 6,1,2, 5,1,2, 2,2,1, 3,2,1, 2,2,1,
   1,2,1, 6,1,2, 6,1,2, 2,2,1, 3,2,1, 2,2,1, 1,2,1, 6,1,1, 7,1,1, 1,2,6, 0,0,0 };
```

Figure 3-20 Custom array of the music score of "Who will you think of when you are lonely"

The specific codes are shown in Table 3-5:

Table 3-5 Music playback frequency table

Define an unsigned string and put it into code FREQH[]={
0xF2, 0xF3, 0xF5, 0xF5, 0xF6, 0xF7, 0xF8, //Bass 1234567
0xF9, 0xF9, 0xFA, 0xFA, 0xFB, 0xFB, 0xFC, 0xFC,//1,2,3,4,5,6,7,i
0xFC, 0xFD, 0xFD, 0xFD, 0xFD, 0xFE, //Treble 234567
Define an unsigned string and put it into code FREQL[]={
0x42, 0xC1, 0x17, 0xB6, 0xD0, 0xD1, 0xB6, //Bass 1234567
0x21, 0xE1, 0x8C, 0xD8, 0x68, 0xE9, 0x5B, 0x8F, //1,2,3,4,5,6,7,i

```
0xEE, 0x44, 0x6B, 0xB4, 0xF4, 0x2D,         // high pitch 234567
0x47, 0x77, 0xA2, 0xB6, 0xDA, 0xFA, 0x16}; //Super high pitch 1234567
According to different processes of timer 0, the longer the interrupt time, the lower the tone, and the shorter the time, the higher the tone. Specific function: timer0(void) interrupt 1 //T0 interrupt program, control the tone of pronunciation
{
speaker=!speaker; // output square wave, pronunciation
TH0=timer0h;     //The next interruption time, this time controls the pitch
TL0=timer0l;
}
Define an unsigned string and put it into code FREQH[]={
0xF2, 0xF3, 0xF5, 0xF5, 0xF6, 0xF7, 0xF8, //Bass 1234567
0xF9, 0xF9, 0xFA, 0xFA, 0xFB, 0xFB, 0xFC, 0xFC,//1,2,3,4,5,6,7,i
0xFC, 0xFD, 0xFD, 0xFD, 0xFD, 0xFE, //Treble 234567
Define an unsigned string and put it into code FREQL[]={
0x42, 0xC1, 0x17, 0xB6, 0xD0, 0xD1, 0xB6, //Bass 1234567
0x21, 0xE1, 0x8C, 0xD8, 0x68, 0xE9, 0x5B, 0x8F, //1,2,3,4,5,6,7,i
0xEE, 0x44, 0x6B, 0xB4, 0xF4, 0x2D,         // high pitch 234567
0x47, 0x77, 0xA2, 0xB6, 0xDA, 0xFA, 0x16}; //Super high pitch 1234567
According to different processes of timer 0, the longer the interrupt time, the lower the tone, and the shorter the time, the higher the tone. Specific function: timer0(void) interrupt 1 //T0 interrupt program, control the tone of pronunciation
{
speaker=!speaker; // output square wave, pronunciation
TH0=timer0h;     //The next interruption time, this time controls the pitch
TL0=timer0l;
```

3.6.1 Music Score and Playback

Five songs were selected in the electronic music doorbell. The music score array corresponding to each song will be shown in the code in the appendix. The song names are: "Fireworks are Easy to Cool", "Only Mom is Good in the World", "Simple Love", "Who Will You Think of When You Are Lonely", and "Falling Like Snow". When defining the music score array, it should be noted that each piece of music is composed

of different notes. There are a total of 7 different note names in the notes, namely: Do Re Mi Fa So La Xi. Each note name has a fixed vibration frequency. The frequency of each note is as follows: So as long as the circuit is used to generate a signal of the corresponding frequency to drive the speaker or buzzer, the corresponding tone can be emitted. Therefore, a signal of a certain frequency is generated by the timer to drive the speaker to emit different sounds. When defining the array, I use three numbers as a group to reflect the notes. The first number is the corresponding number of each tone in the note name, and the second number represents the pitch, such as bass, alto, treble, and super treble, which is often called octave. The number on the third digit mainly represents the length of the pronunciation time. Each array ends with an end mark, which is three zeros. Since there is no pronunciation related to this in the frequency table, it can be used as the end. The frequency-half-cycle data table is referenced during the setting, and the upper and lower eight bits of the frequency-half-cycle data table store a total of 28 frequency data of four octaves [17].

With the above data, it is very easy to play music. Through the T0 interrupt program, you can control the tone of the music. By sending the output square wave through a fixed command line, you can make a sound. So how to get the corresponding timer frequency of the corresponding note is very important. The code is as follows:

The following is the code for playing the song. The system loop reads each bit of the previous score and converts it into the hexadecimal frequency table to control the corresponding delay to process the sound.

```
if(((music_num==1)&&(play_enable==1))&&(power_enable==1))
{
```

The first and seventh digits of the frequency value are used to calculate the frequency of the corresponding note and determine the note and the corresponding octave.

Put the specific frequency value obtained from the previous line of code into the corresponding timer (the music playback corresponds to timer 0 at this time), and then read the frequency value from the data table, which is actually the time length of the timing.

Then put the obtained note frequency into timer T1

time=song1[num+2]; //Read the time length value. When redefining the score, every three digits are a note, so every three digits are a group, so the size of num needs to be increased by three.

num+=3;

The music playback process is shown in Figure 3-21:

Figure 3-21 Music playback process

3.7 Chapter Summary

This chapter focuses on the writing of specific codes for each module and the display of related pseudocodes, including the implementation of electronic clocks, timer settings, electronic music doorbell modules and related button codes and ideas.

Chapter 4 Software Debugging

4.1 Debugging Purpose of MCU Application System

When we are debugging the microcontroller, we first need to test the simulation circuit to see if the connection of each component meets the specifications. After confirming that there is no problem, we set the value of each component, and then write the code. After running correctly, burn it into the corresponding microcontroller. Through simulation, we can observe whether the result input is as expected. We can also find small errors by running step by step, so system debugging is a very important step. Through debugging, we can find problems in both hardware circuits and software circuits and solve them on the spot. Therefore, the more times we debug, the more rigorous and accurate the code will be. We debug until the final system can be error-free and can input and output according to normal conditions. The results of the system may not be as expected but must meet the specifications. The hardware debugging of the system is inseparable from the software debugging. Many hardware failures are discovered and corrected when debugging the software. Usually, the obvious hardware failures in the system are eliminated first and then debugged in combination with the software.

4.2 Debugging software Proteus

The important electronic components used in this product design include AT89C51 single-chip microcomputer, LCD1602 liquid crystal display, digital tube, speaker, crystal oscillator and some capacitors and resistors. The VSS, VDD and VEE ports of the LCD1602 liquid crystal display are connected to the p1.0, p2.0 and p3.0 interfaces of the single-chip microcomputer, RS and RW respectively. At the same time, port E is connected to the P15 port in this design, and the LCD display port 0 to 7 is also connected to the 0 to 7 interfaces of the single-chip microcomputer. The simulation debugging interface is shown in Figure 4-1:

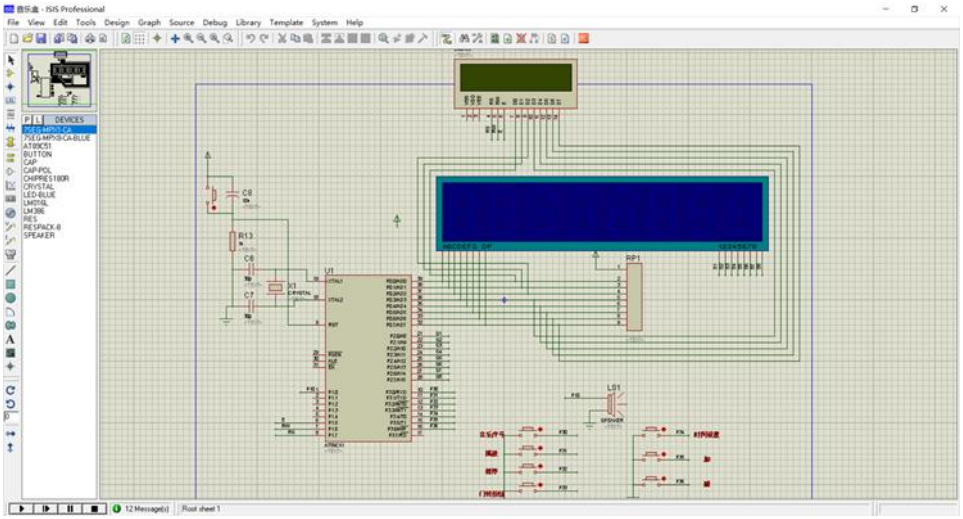

Figure 4-1 Simulation debugging interface

Next is the clock circuit and reset circuit grounding method: the corresponding circuits are connected to the AT89C51 microcontroller XTAL1, XTAL2, RST ports, the p10 port is connected to the speaker, the music sequence number, play, pause, doorbell button, clock setting, and plus and minus buttons in the key circuit are connected to the p3.0 port of the microcontroller to the p3.6 port, the ABCDFEG and DP ports of the digital tube are connected to the p0.0 port of the microcontroller to the p0.7 port, and the 12345678 bit selection interface is connected to the p2.0 port of the AT89C51 microcontroller to the p2.7 port. The operation results are shown in Figures 4-2 and 4-3:

Figure 4-2 The operation result of the digital tube

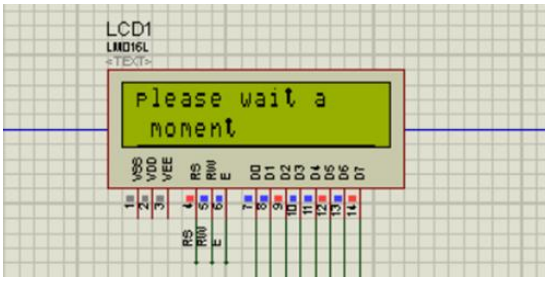

Figure 4-3 LCD1602 display results

The key operation diagram of the clock part is shown in Figure 4-4:

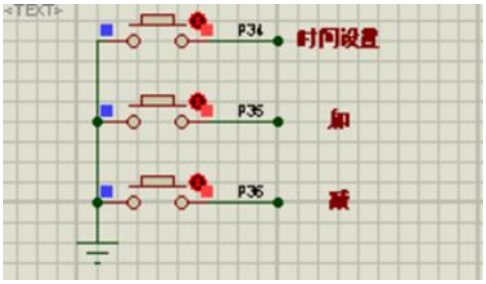

Figure 4-4 Clock key operation diagram

The operation diagram of the electronic music keys is shown in Figure 4-5:

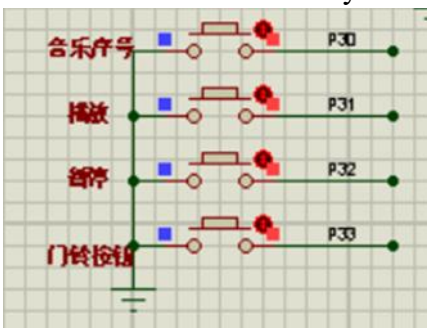

Figure 4-5 Key operation diagram of the music part

The audio amplifier operation is shown in Figure 4-6 and Figure 4-7:

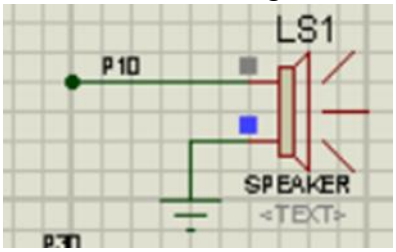

Figure 4-6 Audio amplifier operation results operation diagram

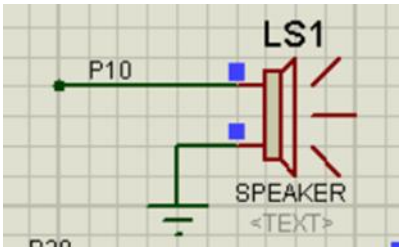

Figure 4-7 Audio amplifier operation results operation diagram

4.3 Keil and Proteus joint debugging

The joint debugging of Keil uvision software and proteus software, and the .hex file compiled by Keil software. Proteus simulation has a function that can input the

program written in Keil, so this design uses this function, and the code burning MCU is shown in Figure 4-8:

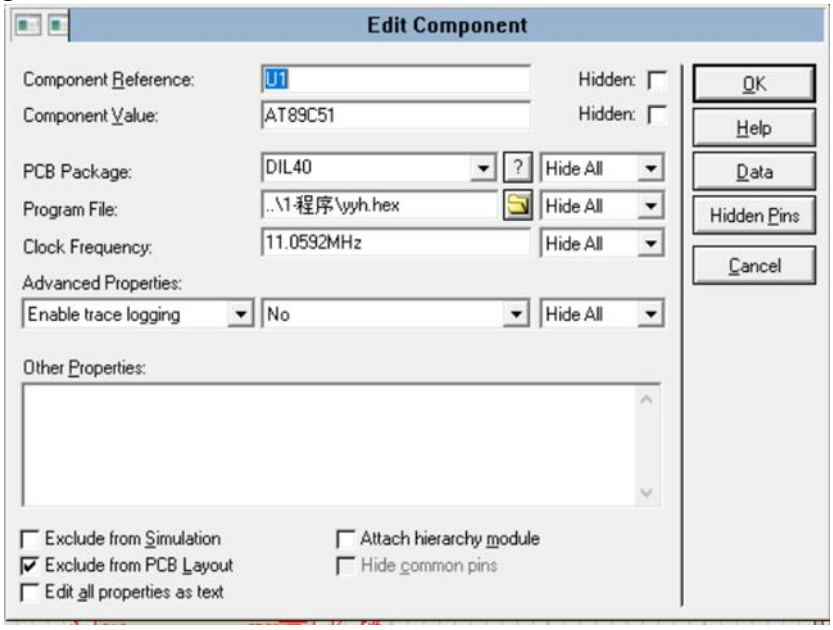

Figure 4-8 Joint debugging of Keil and Proteus

To debug this series of programs, you first need to enter the entire program into the microcontroller, and then complete the simulation debugging through the microcontroller emulator. During debugging, the program also needs to be debugged in the form of small modules, so that the problems of the program can be easily solved and adjusted in time. After that, the small blocks of the program that have been debugged are connected together to complete the overall debugging. When all the programs have no problems, the debugging of the entire program is completed.

In this project, I mainly encountered these problems:

1. Sometimes a program error occurs, and after modification, it still cannot be executed normally. Finally, it is issued because some commands in the programming do not meet the standard. Therefore, some RET return commands must be written in the correct form or try not to have blank lines between two route commands.

2. Solution for normal timing display:

The two timers work together, and there is a problem with the interruption time. When we first start up, we set timer 1 to mode 3, which counts 250 milliseconds. Because the timer is paused too many times, the CPU load is too heavy, causing the song to not be played smoothly and the clock to not be displayed smoothly. Solution: Set timer 1 to work method 1, 16 bits, count 50 milliseconds, and the efficiency has

been greatly improved. We plan to select appropriate modules for systematic analysis in the subsequent debugging.

3. When programming, please note that when the program starts, it should be written at the starting position of the timer or interrupt.

4. When writing comments, be careful to add comments and cutting lines, and pay attention to the content and scope of the comments. Otherwise, if the program is too long, it will appear redundant and cause trouble for later modification and debugging.

5. The program should avoid random calls to upper and lower functions.

6. When writing programs, you must be organized and pay attention to the divide-and-conquer programming philosophy.

4.4 Chapter Summary

This chapter mainly introduces the joint debugging of Keil and proteus, and simulates and debugs the electronic music doorbell, and finally obtains the expected results. Through the combination of pictures and text, the operation results of each module of the doorbell system are displayed and analyzed.

Chapter 5 Results and Outlook

5.1 Summary of design results

The purpose of this design is to make a single-chip electronic music doorbell system. From the construction of the simulation circuit to the realization of the software code, it has the application of three basic modules: electronic music doorbell, clock display, and LCD display. When using the doorbell, users can not only hear different music, but also observe the current time and make arrangements. The LCD display visually reminds visitors to wait for a while, which is more humane.

Single-chip microcomputer technology has made the electronic doorbells used in traditional homes smart and personalized. Because the function of the music doorbell is greatly affected by the development of single-chip microcomputer software, humans can more conveniently adjust the language information content according to actual needs and expand more functions to adapt to reality. With the improvement of electronic science and technology, robots and embedded technology are also playing a more critical role in human daily life. Therefore, single-chip microcomputer technology is designed almost everywhere in human electronic devices. Single-chip microcomputers not only make small household appliances such as electronic doorbells more complete in function, but also cheaper in price and more convenient for people to use.

After a complete system test, the electronic music doorbell system based on Proteus has basically achieved the target function. While completing the requirements of the task book, the LCD screen displays "Please wait a moment" in English, which not only increases the perfection of the system, but also produces a visual effect, which can make visitors feel friendly. The working state is stable and the functions are relatively rich. While playing beautiful music, it also has the functions of electronic clock and display.

5.2 Outlook

Electronic music doorbells are widely involved in human life, but most of the current electronic doorbells only serve to remind the owner to open the door, or to

please the user by improving the sound quality of the electronic doorbell. Most of the time, there are only some ringing functions. So how to add recording or message functions to the electronic music doorbell is a more effective way. The general idea is as follows: when the owner is not at home through the doorbell button and voice prompt program, let the doorbell system send a voice prompt to the visitor: please visit me again later, and at the same time, the English display of "visit me again later" is displayed on the LCD display. The voice prompt can be recorded and put into the doorbell system, which not only politely responds to the visitor's request, but also increases the sense of affection.

Acknowledgements

The work of this graduation thesis was carried out under the careful guidance of Ms. Guo Xun, the instructor. At the completion of the graduation design work that lasted nearly four months, I would like to thank Ms. Guo Xun for her guidance and support. When I first received the project report, I felt very confused. Because I did not have a solid grasp of the knowledge of microcontroller simulation, I did not know how to start at the beginning. However, under the guidance of the teacher, I gradually had a more systematic study of microcontrollers. I slowly sorted out the overall framework in my thinking, from simple components to circuit construction, from software code writing to code burning, and finally completed the design. From Teacher Guo, I not only learned how to learn knowledge systematically, but also learned to be sincere to people, responsible for my studies, and do my work on time.

I would like to thank the teachers who have always guided me. From them, I not only mastered the knowledge, but also became more and more clear about the overall thinking of design. At the same time, I would also like to thank the college for creating an excellent design environment for us throughout the design stage.

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Foreign language materials

Visual Round wireless doorbell in the voice communications system design and implementation

Introduction

Microelectronics technology, wireless technology and network technology for the development of modern people living environment of security, facilitate the provision of a strong technical support, This presents a smart area for the safety of the new wireless doorbell system visualization Round, On the system's overall structure and working principle and the key technology full-duplex digital voice communications for the design and realization of, Analysis of the digital transmission of voice processing, a frame structure on the design and realization of the CPLD in a wireless doorbell system visualization Round-frame synchronization . Finally, the prototype system by the field test, stable performance, reliable, clear voice, has good practical value.

The development of electronic, wireless and network technology provides the strong technical support for security and convenience of modern residential quarters. In this paper, we introduce a new style wireless visual inter-conversation doorbell system, which is used in the intelligent residential quarters. Then explains the structure of this system, and it's full-duplex digital voice communication is designed and implemented. We emphasize the digital voice process in transmission, and discuss the design of the structure of frame, and the frame synchronization realized in CPLD. Finally, the test result shows a stable and reliable quality, clear voice and fairly practical value.

Second: Features

At present domestic doorbell has been a lot of visualization products, mainstream product is wired, one-way voice and Simulation. Visual Round wireless doorbell system combines computer technology, wireless communications and digital signal processing technology used in high-frequency wireless transmitter receiver, installation without cabling, would not undermine the effectiveness of decoration. Visual Round wireless doorbell system is the next generation of electronic security systems, modern gardens, Villa, Villa ideal security device. Family in the living room, through the screen to see images, voice speaking, remote understanding of the situation outside, accurate judgment visit in the capacity of the reception to decide whether to open the door to

protect the family's personal and property safety. The system uses modular hybrid technology, digital voice, video simulation, the future is all-digital wireless doorbell system visualization talk of a transition, the system's main features are:

(1)2.4 GHz, 900MHz high-frequency signal transmission.

(2)In the 60 m clearly within the scope of stable transmission audio and video signals at a barrier such as distance is 30m.

(3)If on the doorbell, "Ding Dong" Sound hints open automatically monitor screen

(4)Wireless unlock, and control of the electric door lock control.

(5)Indoor Wireless proactively monitor.

(6)Delay shut down automatically monitoring system.

(7)Wireless transmission, the receiver can be easily placed, easy installation.

(8)Wireless full-duplex voice communication.

The system is composed of two parts: part of indoor and outdoor part. Visual Round wireless doorbell system uses full-duplex digital wireless voice programmes, indoor and outdoor machines are corresponding to the four basic modules, including A / D / A modules from voice codec chip MC145481 completed, the speech signal processing module from the CPLD digital voice signals as well as a package of reconciliation package synchronization, thereby enhancing anti-jamming capability. wireless transmit / receive modules to deal with the digital signal modulation and demodulation, it suitable for wireless channel transmission.

Voice transmission processing

Although voice processing digital signal transmission than analog signals have great advantages, but digital signal analog signal difficult than receiving, processing requirements more stringent than the analog signal, with the development of society, wireless communication equipment widely used, resulting in increased electromagnetic interference, and advances in technology enabling wireless receiver continuously improve receiver sensitivity, wireless receiver in the corresponding sent equipment will not be there when the output data demodulation. Wireless communications must be according to data frame transmission of data packet, and must be adopted and reliable way to ensure the frame synchronization of data from the chaos of the data frame will be legitimate identified. Frame synchronization can be used in synchronous or synchronous code. Synchronization of the relatively high hardware requirements to achieve more difficult, it seldom use more than a code synchronization. Synchronous

Code should ensure that the choice of code and data re-synchronization code probability as low as possible, so as to the general application of the HS .That the need for re-design code to escape if a frame set up between the timer and overtime provisions of the transfer agreement in the data frame length, frame synchronization code can be arbitrary choice, the general choice 0xAA, 0x55, such as 0 - 1 uniform distribution of data, and in order to improve reliability, often the choice of multi-byte frame synchronization code, such as 0xAA 0xBB (2-byte frame synchronization code).

To establish stable communication, a standard wireless data transmission frame should include at least the following parts:

(1) Jumping code: in the receiving establishment phase, providing reception threshold level, its length and hardware relevant data, wireless doorbell system visualization Talkback used in the x99 is 0.

(2) redundant code: According to experience, usually adopts a 0xff or 0xff, 0x66 results were relatively good, and the establishment of communication to correct errors arising from the phase-out-of-step serial receiver, in the slow speed (< 19200 bps), the two often use L-redundant code is not adopted in the design.

(3)Synchronous Code: used for frame synchronization, data transfer and use of relatively low-bit-rate code word, and in order to improve reliability, and a 2-byte or 2 bytes above synchronous code words such as 0xaa 0xbb. Visual Round wireless doorbell system is used in the 0xCCCCCC.

(4)Data: users want to transfer data to improve the reliability of communications, the proposed Manchester encoding the data or using DPCM send, and data validation. Manchester encoding or used in the DPCM transmitted, the length of the data generally should not exceed 256 bytes; on the contrary, should not exceed 64 bytes. But speaking in the wireless doorbell visual system, digital voice transmitter module maximum data transmission rate of 76.8 kbps, but the voice from the A / D chip from 64 kbps data there, as affected by the CPLD antenna bandwidth capacity and launch two factors constraints, we do not have to deal with complicated coding. 0 x99 precursor for which code for the initial bit synchronization and receive state machine reset, 0xCCCCCC data frame synchronization code , frame synchronization for eight yards behind-control code. Visual Round wireless doorbell system in the control code number of small, indoor to outdoor is three, has taken the initiative to monitor the lock, removable hang up. Outdoor to indoor control signal only a call button, we will design the frame

synchronization byte code for the control signal transmission in the back to keep up with the control signal in bytes of voice and data units.

Software using top-down design methodology, a total of five documents: the top-level documents were, transmit modules accept modules, digital phase-locked loop and frame state machine. Top-level document for the system clock with a 2048 kHz voice codec interface chip MC145481, including sending and receiving of two functional modules L module which is sent to send data in the original data before adding header, voice communications frame 0x99 first, 0xCC, 0xCC, 0xCC, followed by the control signal byte, in bytes of voice and data units for L receiver module is to detect and control the speech signal, the relatively complex, including digital phase-locked loop and frame status two-state, if detected 0xCC, 0 from the state into a state if a byte is 0xCC from a state into two states, or else to return to state 0; If the first three bytes or 0xCC from entering the state 2 3 state into synchronous state, or to return to state 0 which DPLL is a bit synchronization.

As voice signals are relatively weak in general, according to M u/A code of law, may be even longer, "1", so that the receiver can not extract the correct information in sync, so we carried out a simple voice and data handling, even if "1" is greater than the number eight, an eighth reverse, namely, "1" to "0." As one of the quantitative data sampling points last a minimum weights, this will not deal with the impact of.

Concluding remarks

Based on the visual-speaking wireless doorbell system, and its two-way voice communications for the design and realization, it is has been tested and empty distance of 60 m, 30 m to obstructions, clear voice L test results show that the design of a performance stable and reliable, clear voice, simple design, and other features, the value of L practical course of the program in this paper on the properties have yet to be improved, then we have to do the work is the image of real- time digital information transmission, thus achieving all-digital wireless Visualization Round doorbell system.

Translation of foreign language materials

Design and implementation of voice communication system in Visual Round wireless doorbell

Introduction:

Microelectronics technology, wireless technology and network technology provide strong technical support for the development and convenience of modern people's security living environment. This time, a new visual wireless doorbell system is proposed for the field of intelligent security. The overall structure of the system, the working principle and key technologies of the full-duplex digital voice communication are designed and implemented, the digital transmission voice processing analysis, the CPLD framework structure design and implementation of the visual circular frame synchronization of the wireless doorbell system. Finally, the prototype system has been tested on site, and the performance is stable and reliable, the sound is clear, and it has good practical value.

The development of electronic, wireless and network technologies has provided strong technical support for the security and convenience of modern residential quarters. This paper introduces a new wireless video intercom doorbell system applied to smart quarters. Then the structure of the system is explained, and full-duplex digital voice communication is designed and implemented. The digital voice process in transmission is emphasized, and the design of the frame structure and the frame synchronization implemented in CPLD are discussed. Finally, the test results show that the quality is stable and reliable, the sound is clear, and it has considerable practical value.

Features:

At present, there are many visual doorbell products in China, and the mainstream products are wired, one-way voice and simulation. The Visual Round wireless doorbell system combines computer technology, wireless communication and digital signal processing technology, and is applied to high-frequency wireless transmitters and receivers. It does not require wiring for installation and will not damage the decoration effect. The Visual Round wireless doorbell system is the next generation of electronic security system and is an ideal security device for modern gardens, villas and villas. Family members in the living room can watch images on the screen and speak by voice

to understand the situation outside remotely, accurately judge the reception capacity of visitors, decide whether to open the door, and protect the personal and property safety of family members. The system adopts modular hybrid technology, digital voice, and video simulation. It is a transition to the visualization of the future all-digital wireless doorbell system. The main features of the system are:

(1) 2.4GHz, 900MHz high frequency signal transmission.

(2) The distance between obstacles for stable transmission of audio and video signals within a range of 60 m is 30 m.

(3) If the doorbell rings, the "Ding Dong" sound prompts you to turn on the automatic monitoring screen

(4) Wireless unlocking and electric door lock control.

(5) Indoor wireless active monitoring.

(6) Delayed shutdown automatic monitoring system.

(7) Wireless transmission, the receiver can be easily placed and installed.

(8) Wireless full-duplex voice communication.

The system consists of two parts: indoor part and outdoor part. The Visual Round wireless doorbell system adopts a full-duplex digital wireless voice solution. The indoor and outdoor units correspond to four basic modules, of which the A/D/A module is completed by the voice codec chip MC145481, and the voice signal processing module is synchronized by the CPLD digital voice signal package and unpacking, thereby enhancing the anti-interference ability. The wireless transmission/reception module handles the modulation and demodulation of digital signals and is suitable for wireless channel transmission.

Voice transmission processing:

Although voice processing digital signal transmission has great advantages over analog signals, digital signals are more difficult to receive than analog signals, and the processing requirements are more stringent than analog signals. With the development of society, the widespread application of wireless communication equipment has led to an increase in electromagnetic interference, and the advancement of technology has continuously improved the receiving sensitivity of wireless receivers. The demodulation output data will not appear when the wireless receiver corresponds to the sending device. Wireless communication must be transmitted according to the data frame of the data packet, and a reliable frame synchronization method must be used to ensure that the

data is legally identified from the chaotic data frame. Frame synchronization can be used for synchronization or synchronization code. Synchronization has high hardware requirements and is difficult to implement, so multi-code synchronization is rarely used. Synchronous Code should ensure that the probability of the selected code and data resynchronization code is as low as possible to facilitate the general application of HS. If a frame is established between the timer and the timer, the code needs to be redesigned for escape timeout. The length of the data frame is specified in the transmission protocol, and the frame synchronization code can be selected arbitrarily. Generally, 0xAA, 0x55, 0-1 and other uniformly distributed data are selected, and in order to improve reliability, multi-byte frame synchronization codes are often selected, such as 0xAA 0xBB (2-byte frame synchronization code).

In order to establish stable communication, a standard wireless data transmission frame should at least include the following parts:

(1) Code hopping: In the reception establishment phase, the reception threshold level, length, and hardware-related data are provided. The visual intercom of the wireless doorbell system used in x99 is 0.

(2) Redundant code: According to experience, 0xff or 0xff, 0x66 are usually used, which have better effects and can correct errors caused by the loss of synchronization of the serial receiver when establishing communication. At slow speeds (< 19200 bps), these two commonly used L-redundant codes are not used in the design.

(3) Synchronous Code: This is used for frame synchronization, data transmission, and codewords with relatively low bit rates. To improve reliability, a 2-byte or 2-byte suffix is added to the synchronization codeword, such as 0xaa 0xbb. The Visual Round wireless doorbell system uses 0xCCCCCC.

(4) Data: Users want to transmit data to improve the reliability of communication. It is recommended to Manchester encode the data or use DPCM to send and verify the data. Manchester encoding or DPCM for transmission, the data length should generally not exceed 256 bytes; on the contrary, it should not exceed 64 bytes. However, in the wireless doorbell visual system, the maximum data transmission rate of the digital voice wireless transmitter module is 76.8 kbps, but the voice data from the A/D chip is 64 kbps. Because of the two factors of CPLD antenna bandwidth capacity and transmission capacity, we do not have to deal with complex encoding. The 0x99 preamble is the initial bit synchronization and the reset of the receiving state machine, the 0xCCCCCC

data frame synchronization code, and the eight-code control code after the frame synchronization. The number of control codes in the Visual Round wireless doorbell system is small, three for indoor and outdoor, with active monitoring locks and detachable hooks. The control signal from outdoor to indoor has only one call button. We will design the frame synchronization byte code for the subsequent control signal transmission to keep up with the number of bytes and data units of the control signal.

The software adopts a top-down design method, with a total of five files: top-level file name, sending module, receiving module, digital phase-locked loop and frame state machine. The top-level file is the system clock, with a 2048 kHz voice codec interface chip MC145481, including two functional modules: sending and receiving. The sending module adds a header to the original data before sending the data. The voice communication frame is first 0x99, 0xCC, 0xCC, 0xCC, followed by the control signal byte, in bytes, in voice and data units. The receiving module detects and controls the voice signal, which is relatively complex, including two states: digital phase-locked loop and frame state. If 0xCC is detected, if a byte enters a state from 0 state, 0xCC enters two states from one state. state, otherwise it returns state 0; if the first three bytes or 0xCC enter from state 2 3 state to enter the synchronous state, or returns state 0 where the DPLL is bit synchronous.

Since voice signals are generally weak, according to the Mu/A code rule, they may be longer, "1", so that the receiver cannot extract the correct information synchronously, so when we perform simple voice and data processing, even if "1" is greater than the number eight, the eighth one is inverted, that is, "1" becomes "0". As the last minimum weight of one of the quantized data sampling points, this will not affect the processing.

Summarize:

Based on the video intercom wireless doorbell system, its two-way voice communication is designed and implemented. After testing, the open distance is 60 m, the distance to obstacles is 30 m, and the voice is clear. The test results show that the design has the characteristics of stable and reliable performance, clear voice, simple design, and the performance of the program of the practical course in this article needs to be improved. Then what we have to do is to transmit digital information in real time, so as to realize the fully digital wireless visual circular doorbell system.