Pisco Med Publishing

Communication Electronic Single-Chip Digital Clock

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***Abstract*:** At the end of the 20th century, the rapid development of electronic technology in its promotion had effectively promoted the development of social productive forces and social information to improve the degree. People of modern life pay more attention to the concept of time as compared to before. It can be said that time and money to draw the equal sign. For those who are very strict and accurate to grasp the time or things, the time is not accurate will bring a lot of trouble so the digital tube for the display clock than the pointer clock showed a great advantage. Digital display time is simple and clear while the time accurate display to seconds. Whilst we mechanically dependent on the crystal oscillator, it may sometimes lead to errors. Digital clock is the use of digital circuits to achieve 'time', 'minutes', 'seconds' digital display of the time device. Digital clock accuracy, stability far more than the old mechanical clock. In this design, we use LED digital tube display, minutes, seconds and 24-hour chronograph according to the digital tube dynamic display principle to display with 12MHz crystal oscillator oscillation pulse, timer count. In this design, the circuit has the display time of its function and can achieve the adjustment of time. Digital clock is its small, low price, travel time, high precision, easy to use, more features, easy to integrate and the majority of consumer favorite to get a wide range of use.

***Keywords*:** Digital Clock; Single-Chip; Circuit; Display Time

1. Introduction

1.1 Digital electronic clock background

At the end of the 20th century, the rapid development of electronic technology, modern electronic products almost penetrated the various fields of society and had effectively promoted the development of social productive forces and social information to improve the degree. Time is always so valuable to people, the work of the busy and complex easy to make people forget the current time. However, for the important things, a temporary delay may lead to disaster.

At present, the microcontroller is moving towards high performance and multi-variety direction of the trend will be further toward the CMOS, low power consumption, small size, large capacity, high performance, low price and external circuit built in several aspects of development. The following is the main development trend of single-chip. The significance of single-chip microcomputer application is that it fundamentally changed the traditional control system design ideas and design methods. Never before by the analog circuit or digital circuit to achieve most of the functions and now has been able to use the microcontroller through software to achieve. This software instead of hardware control technology, also known as micro-control technology is a revolution in traditional control technology.

Single-chip module is the commonest digital clock. Digital clock is a digital circuit technology to achieve hours, minutes and seconds of the device as compared with the mechanical clock has a higher accuracy and intuition and no mechanical devices which has a longer service life, therefore has been widely used.

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1.2 The meaning of digital electronic clock

Digital clock is the use of digital circuits to achieve. Hours, minutes, seconds. Digital display of time devices, widely used in personal homes, stations, terminals and other public places, as people's daily necessities of life due to digital integrated circuits development and the widespread use of quartz crystal oscillator, making the accuracy of the digital clock far more than the old-fashioned watches. Watches and clocks to the digital production and life has brought great convenience and greatly expanded the original clock timekeeping function. For instances, automatic timer alarm, automatic ringing on time, time program automatic control, regular broadcast, automatic closed street lights, timer switch oven, power off the power equipment and even a variety of regular electrical automatic activation, all of these are digital watch based on. Therefore, the study of digital clock and expand its application, has a very real significance.

Digital electronic clock application

Digital clock has become a daily necessities of life: Essential necessities, widely used in personal families and stations, docks, theaters, offices and other public places, to people's lives, learning, work and entertainment to bring great convenience.

Due to the development of digital integrated circuit technology and the use of advanced quartz technology, digital clock with travel time accuracy, stable performance and easy to carry. It is also used for timing, automatic timekeeping and automatic control and other fields.

2. Overall design

2.1 Single-chip selection

Microcomputer is an important branch of micro-computer and viable models. Single-chip microcomputer referred to as single-chip, especially for the control field, it is also known as micro-controller.

Typically, the microcontroller consists of a single integrated circuit chip which contains the basic functions of the computer: the central processor, memory and I / O interface circuit. Therefore, the microcontroller and the need only appropriate software and external equipment, can become a single-chip control system.

The development of single-chip microcomputer, in the direction of multi-function, high performance, low voltage, low power consumption, low price, large storage capacity, strong I / O function and better structure compatibility, The Its development trend is nothing more than the following aspects:

(1) Multi-function
(2) High efficiency and high performance
(3) Low voltage and low power consumption
(4) Low price

At present, China's production of many models of single-chip, in this, we use the model STC89C52 single-chip. This is because: STC89C52 is a low-voltage, high-performance CMOS 8-bit microcontroller, the chip contains 4k bytes of rewritable flash read-only program memory and 128 bytes of random access data memory (RAM), the device using ATMEL's high Density, nonvolatile storage technology, compatible with standard MCS-52 instruction system, built-in general-purpose 8-bit central processing unit and flash memory unit, built-in powerful microcomputer AT89C52 provides a cost-effective solution.

STC89C52 is a low power high performance microcontroller, 40 pins, 32 external bi-directional input / output (I / O) ports, including two external interrupts, two 16-bit programmable timer counter, two full Duplex serial communication port, STC89C51 can be programmed in accordance with conventional methods, can also be programmed online. It combines a common microprocessor and Flash memory, especially the rewritable Flash memory can effectively reduce development costs.

2.2 The basic structure of the microcontroller

MCS-52 microcontroller internal structure

The 8052 microcontroller includes a central processor, program memory (ROM), data memory (RAM), timing / count

Device, parallel interface, serial interface and interrupt system and other large units and data bus, address bus and control bus and other three major bus.

3. Hardware design of digital clock

3.1 Minimum system design

The minimum system of the microcontroller is composed of power, reset, crystal, / EA = 1.

3.2 LED display circuit

The display is widely used to visually display the running status and working data of the digital system. According to the material and product technology, the display devices commonly used in single-chip microcomputer system are: LED display, LCD display, CRT display and so on. LED display is now one of the most commonly used monitors, as shown below.

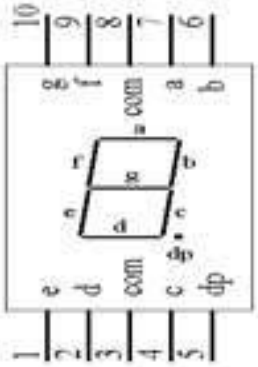

Figure 3-2; Symbols for LED displays**.**

Light-emitting diodes (LEDs) are made of special semiconductor materials gallium arsenide, gallium arsenide, can be used alone and be assembled into a segmented or dot matrix LED display device (semiconductor display). The segmented display (LED digital tube) consists of seven segments surrounded by 8 fonts, each containing a light-emitting diode. In addition, the forward voltage when the diode conduction, issued a clear light. As long as the law according to the control of the light section of light, off, you can display a variety of glyphs or symbols. LED digital tube has a total of yang, a total of Yin points. Figure is a total of Yang, a total of Yin LED digital tube schematic and symbols.

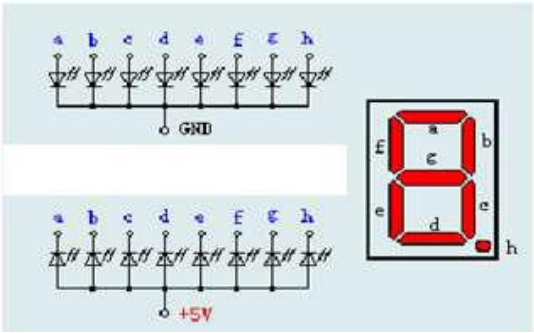

Figure 3-3; Common yang, a total of Yin-type LED digital tube schematic and digital tube symbol map**.**

Display circuit display module needs real-time display of the current time, real time, minutes, seconds, 6 digital tube and another two digital tube to display horizontal. Using the dynamic display mode to display the time, the hardware connection as shown below, when the ten and a bit were shown in the first and second digital tube, sub-ten and a bit were shown in the fourth and fifth Digital tube, seconds of the ten and a bit were shown in the seventh and eighth digital tube, the rest of the digital display horizontal line. LED display display control by the drive can be divided into static display and dynamic display of two ways. For multi-bit LED display, usually using dynamic scanning method to display, the hardware connection as shown below.

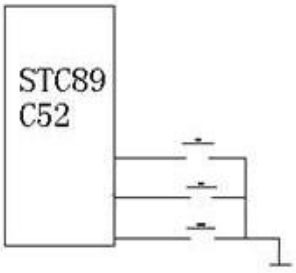

Figure 3-4; Schematic diagram of the hardware connection of the digital tube**.**

Digital control conditions:

A. Section and decimal point plus current limiting resistor

B. The use of voltage: paragraph: according to the luminous color decision; decimal point: according to the luminous color decision

C. The use of current: static: total current 80mA (each 10mA); dynamic: average current 4-5mA peak current 100mA Digital tube use Note:

(1) Digital tube surface do not touch by hand, do not hand to get the lead angle;

(2) Welding temperature: 260 degrees. Welding time: 5S

(3) Products with protective film on the surface that can be torn off before use. 3.3 Keyboard control circuit

The design requires proofreading time, so use three keys to achieve. Press khour to adjust the hours of time, press kmin to adjust the minute hand time, press ksec to adjust the time of seconds. The following figure is the key hardware connection diagram.

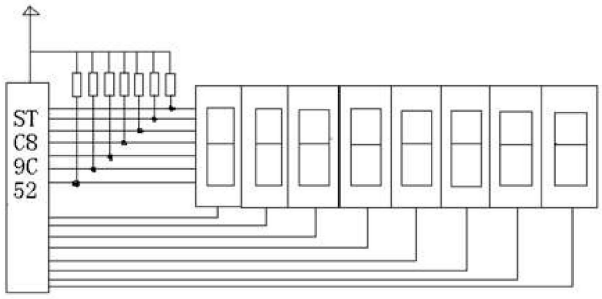

Figure 3-5; Hardware connection diagram of the key control circuit**.**

When you press a key by hand, as shown in **Figure 3-6**, often press the key in the closed position and the open position to jump a few times to stabilize to the closed state of the situation. In the release of a key, it will appear similar case. The duration of the jitter varies with the keyboard material and the operator and is usually not longer than 10ms. It is easy to think that the jitter problem is not resolved will cause the recognition of the closed key. With the software method can easily solve the jitter problem, which is delayed by 10ms to wait for jitter to disappear, after which, read the keyboard code.

4. Digital Clock Software Design

The system software design is also the design of the tool system function. SCM software design includes the implementation of software (to complete a variety of substantive functions) design and monitoring software design. SCM software design usually have to consider the following aspects of the problem:

(1) According to the requirements of software function, the system software is divided into several relatively independent parts and the reasonable overall structure is designed to make the software development clear, concise and reasonable.

(2) To develop a good programming style, such as considering the structure of the program design, the implementation of modular, subroutine. Both easy to debug, link, and easy to transplant and modify;

(3) To establish the correct mathematical model, through simulation to improve the performance of the system, and select the appropriate parameters;

(4) To draw the program flow chart;

(5) Rational allocation of system resources;

(6) For the program to add notes, improve readability, the implementation of software engineering;

(7) Attention to the anti-jamming design of the software to improve the reliability of the system.

4.1 System software design flow chart

This digital clock design uses a lot of subroutines, and their flow charts are shown below.

The main program is the first start, and then start the timer, the timer starts after the key detection, after testing, you can display the time.

Press the key to press the key to press the key to press the key to press the second button if the press then the second is added. Press the key when testing

Whether to press, when the button if you press, when the plus 1; if not pressed, put the time to show it.

When the timer is interrupted, the first detection of 1 second is to, 1 second if to while the second unit to increase. If not to, the detection of 1 minute is to, 1 minute if to and sub-unit plus 1. Detection of 1 hour is to, 1 hour if to, when the unit plus 1, if not to show the time.

Time display is the first seconds to calculate the number of bits, and then the second ten-bit calculation shows that the sub-bit calculation is displayed and then sub-ten shows there is a bit when the calculation shows that the last ten shows.

4.2 Digital clock schematic

With PROTUES software, according to the requirements of the digital electronic clock to draw the schematic as shown below.

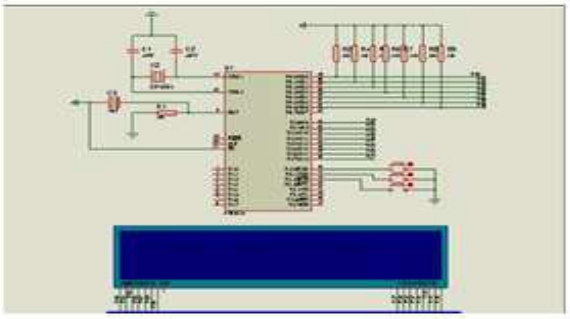

Figure 4-5; Schematic diagram of the digital clock**.**

In this it is necessary to introduce the working principle of digital electronic clock:

A digital electronic clock is a timepiece that displays 'hour', 'minute', 'second' on a human visual organ. Its timing period is 24 hours, showing full scale of 23:59 and 59 seconds, in addition to school function. Therefore, a basic digital clock circuit mainly by the display 'time', 'minutes', 'seconds' and the microcontroller,

as well as school circuit. 8 digital tube segment selected to the microcontroller 0 port, bit selected to the microcontroller P2 port. Digital tube in accordance with the principle of digital display work, the standard seconds into the 'second unit', 'second unit' using 60 hexadecimal counter, each 60 seconds to send a 'sub-pulse' signal, the signal will be ' Sub-unit 'of the clock pulse. The 'unit' also uses a 60-bit counter, which accumulates a 'pulse' signal for 60 minutes each, and the signal is sent to the 'unit'. 'Unit' using 24-band timer, can be achieved 24 hours a day cumulative. The display circuit displays 'hour', 'minute', 'second' through the seven-segment display. School clock when used to 'time', 'minutes', 'seconds' to show the number of proofreading adjustment, click on the ksec, seconds unit plus 1, click on the kmin, points on the plus 1, click khour, 1.

5. System Simulation

5.1 PROTUES software introduction

Proteus software is Labcenter Electronics company circuit design and simulation software, which includes ISIS, ARES and other software modules, ARES module is mainly used to complete the PCB design, and ISIS module used to complete the circuit schematic layout and simulation. Proteus software simulation based on VSM technology, it is the biggest difference with other software is the biggest advantage is that it can simulate a large number of single-chip chips, such as MCS-51 series, PIC series and so on, and microcontroller peripheral circuits, such as keyboard, LCD and so on. Through the use of Proteus software we can easily get a full-featured, practical and convenient single-chip lab.

5.2 Electronic clock system PROTUES simulation

With PROTUES software, according to the schematic diagram of the digital electronic clock, draw the simulation map, get the following figure.

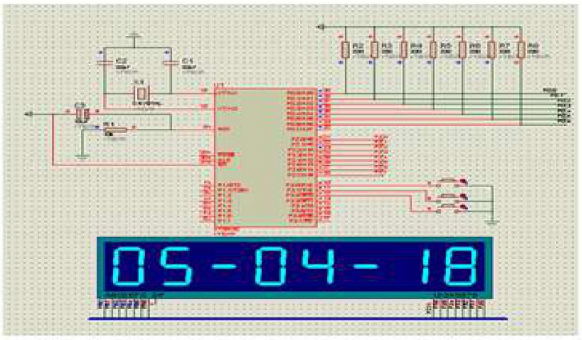

Figure 5-1; PROTER simulation of the digital clock**.**

6. Debugging and Functional Description

Debugging of the microcontroller application system includes both hardware and software, but they are not completely separate. The general method is to remove the obvious hardware failure, and then integrated debugging, troubleshooting possible software / hardware failure.

6.1 Hard disk debugging

After getting the circuit board, first check the quality of processing and ensure that there are no errors, such as short circuit and open circuit, especially to avoid power short circuit; components in the installation before the one by one check, use a multimeter to measure its value, The same; after the completion of welding, the first no-load power (chip chip does not insert the chip), and check the pin's potential is correct. If all normal, only in the case of power will be inserted into the chip, once again check the potential of the pin and its logical relationship. The multimeter probe into the microcontroller connected to the power pin on the test to see if it meets the requirements.

6.2 System performance test and function description

Travel time: the default time to travel, according to the 24-hour system, respectively, show 'time - minutes - seconds', there are two '-' dynamic display, the time will be the actual time in seconds for the least unit changes.

Travel time adjustment: press ksec to adjust the second, press the plus one second. Press kmin to adjust the points, click on the plus one. Press khour on the time to adjust, click for one hour, so as to achieve the purpose

of quickly set the time.

6.3 System clock error analysis

Time is a basic physical quantity with continuous, automatic passing, no repetition and other characteristics. China's time benchmark from the national timing center, people use the clock is a certain degree of accuracy with the benchmark to keep pace. Combined with the concept of time and error theory, you can define the electronic clock travel time error S = S1-S2, S1 said the actual operation of the program calculated seconds. S2 said the objective time standard seconds. S> 0 that the electronic clock seconds unit value refresh lag, that is, the travel error is 'slow'; the other hand, S <0 means the second unit value refresh ahead, that is, the travel time error is 'fast'.

The main source of the error in the design of the electronic clock system, including the crystal frequency error, the timer overflow error, delay error. The frequency of the crystal overflow, easy to produce travel time error; timer overflow time error, this should be a second overflow, but in the next second overflow, resulting in travel time error; delay time is too long or too short, will cause deviation with the reference time , Resulting in travel time error.

6.4 Software debugging problems and solutions

Software program debugging can generally focus on sub-module debugging, the tone is the last ring. Software debugging

You can take off-line debugging and online debugging in two ways. The former does not require a hardware emulator, which can be simulated by means of software.

Keil software is used to debug the program, through the various modules of the single-step or follow-up debugging process, so that the program gradually tends to correct, and finally adjust the program.

Simulation part of the protus 6 professional software, this software is powerful and relatively simple operation, you can easily achieve a variety of system simulation.

First open the protus 6 professional software, in the library to find all the components to be selected, and then the schematic drawing; draw and then select wave6000 has been compiled good * .hex file, select the operation, observe the display, according to the display Results and the requirements of the subject and then modify the program, and then run the investigation, until to meet the requirements.

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