# The design of the bus automatic stop announcer based on single chip microcomputer

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**Abstract:** The so-called automatic bus stop announcer system refers to a kind of control system which takes microcontroller and other micro-processors as the main control core and combines with related functional sensors outside of the chip. This subject takes this system as the research object, and chooses STC89C51 microcontroller which is commonly used in University as the main control chip. An embedded system is designed to realize the functions of bus platform information display and voice broadcasting. Because of the small shape of various chips and sensors used in the system, the external volume of the whole system is also very small, which achieves the portable index. This system is constructed by STC89C51 MCU minimum system, LCD1602 LCD display circuit, Beijing time timing circuit and parameter broadcast circuit in hardware, and by main program, LCD driver subroutine, DS1302 driver subroutine and live voice broadcast subroutine in software. In order to intuitively see the working status of the design results, many tests have been carried out in the verification part of the project, and various functional indicators have been tested. The test results show that all the work of this bus automatic stop announcer system is normal and meets the anticipated design requirements.

**Keywords:** Bus stop announcer, live voice broadcast, STC89C51 microcontroller.

## 1. Introduction

This project will make a detailed research and design on a bus automatic station announcer system with STC89C51 single chip as the core processor. The reason why STC89C51 single chip is selected as the main controller in many common microprocessor chips is to take into account the research basis of predecessors and the advantages and disadvantages of most products in the current market. It is believed that the control of STC89C51 single chip can achieve the expected objectives

of the subject, and optimize and avoid the common defects of some bus automatic stop reporting system, and further improve the performance of some excellent design cases on the market at present, which is also the purpose and significance of the subject. From the perspective of the whole development background of the system, from the original traditional bus automatic stop reporting system to the digital or intelligent bus automatic stop reporting system, no matter how excellent the system is designed, or how thoughtful the software and hardware designers consider, the bus automatic stop reporting system always shows a variety of failures in the process of work. The most common is the crash phenomenon in the process of system operation[1-3]. The so-called crash phenomenon refers to the phenomenon that the program code inside the microprocessor runs away and cannot execute the process work according to the program designer's plan. Once the crash occurs, the system cannot continue to work normally. This phenomenon is a mature operation from the appearance of the single-chip microcomputer system to the present. There is an inevitable phenomenon in the operation system[4-6]. There are two main reasons for these failures in the integrated bus automatic stop announcer system. The first is that the performance of the main control microprocessor chip is limited. Whether it is the early low-end microprocessor chip or the current 32-bit or 64 bit microprocessor, its internal resources are very limited, especially RAM storage area is used to store program variables. The space size of this area can largely determine the complexity of the bus automatic stop announcer system. If this area can be designed large enough in an ideal situation, the bus automatic stop announcer system can achieve more complex functions. The second reason is the qualification level of the programmer himself. Improper memory operation will cause all kinds of crashes, so it is necessary for the programmer to take this into account. Before the products related to the automatic bus stop reporting system are put into the market, the R & D enterprises need to make a detailed planning for the R & D cost of the automatic bus stop reporting system, because only one product with high cost performance ratio can achieve the performance above the overall average level and the cost of the product is a competitive product, so the automatic bus stop reporting system is a competitive product. In the development process of the system, designers always like to choose the main control microprocessor with the highest performance price ratio as the main control. Nowadays, the 32-bit microprocessor STM32 is a very popular chip, which has been embedded in most of the bus automatic station announcer systems and other control systems. It can not only realize bare machine work, but also realize more complex operation. On the basis of previous work, this paper selects a STC89C51 single chip microcomputer with high cost performance to realize a bus automatic stop reporting system.

At present, many enterprises at home and abroad have launched automatic bus stop announcer products that can realize the bus stop announcer control system with excellent performance and high output accuracy, and can stably realize the display of system parameters, automatic timing and voice broadcast[4-6]. This topic has conducted extensive data review and Research on the development status of the system at home and abroad, and found that the public At present, the traffic automatic station announcer system does not need to rely on imports at home. No matter the R & D of internal core technology or the assembly of products, a mature industrial chain has been formed at home. Especially for the R & D of the new type of bus automatic station announcer system, the R & D personnel at home and abroad have learned and summarized the excellent design cases at home and abroad, which is completely feasible, In order to design their own automatic bus stop reporter system.

## 2.  System Design

In order to be able to more clearly explain the construction of the system in the internal structure framework, so as to design the overall design scheme of the bus automatic stop announcer system, the STC89C51 single chip microcomputer is the most important part of the minimum system, which is the control part of the whole system, to achieve the control of each functional circuit. When the bus enters the station, the driver presses the key corresponding to the platform in the key module, and then STC89C51 single chip computer responds to the key. First, the single chip computer transmits the character code of the platform name corresponding to the platform to the LCD screen, and displays the information of the platform under the drive of the internal control chip. Then STC89C51 MCU will start the voice broadcast module, send out the address corresponding to the platform information voice file in the voice module, the voice module can find the voice file through the address, and broadcast the voice file through the internal decoder and power amplifier.

STC89C51 MCU has rich external interfaces. As shown in Figure 1, not only 32 GPIO pins can be provided to users, but also a UART serial port interface with stable performance. Users can control the RXD and TXD pins of this chip through program code to realize serial port communication function. In addition, the pin interrupt resources of this main control microprocessor are also very rich through program. The control of the code can capture the rising and falling edge of the external signal, and realize some complex control processes. The flash size of this bus stop reporting system is 4K bytes. This part is mainly used to store the C language program code written by the user. The feature of this storage space is that it is unable to modify the internal data online. Only after the entire space is erased by a special burning device, can new data be added, next to this storage space. Is a 256 byte ram part, which is

used to store the variable values built by the user in the program.



Figure 1 STC89C51 single chip microcomputer

In the hardware system, the first thing we need to design is the minimum system circuit of STC89C51 single chip microcomputer. The importance of this circuit has been introduced above. It is mainly to drive LCD1602 LCD circuit, RTC timing circuit and real voice broadcast circuit in this project. The main design content of this part is reset circuit and crystal oscillator.

The design idea of reset circuit is to make the circuit output high level after pressing the key in the figure below. Because STC89C51 single chip is a high level reset chip, according to the circuit structure in Figure 2, when the key is not pressed, the circuit output low level can be reset, and the high level can be output after pressing the key.
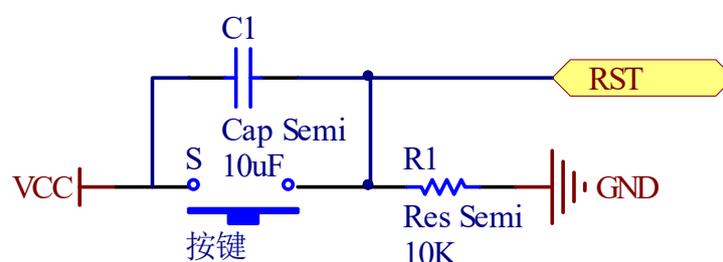


Figure 2 Reset circuit design

The design idea of crystal oscillator circuit is relatively simple. As shown in Figure 3, only two small capacitors of about 30pf need to be connected at both ends of 12m crystal oscillator, and then two pins are connected to xtal1 and xtal2 pins of STC89C51 single chip.

As shown in Figure 4 is the appearance of this RTC chip. In terms of working parameters, this clock chip can show the performance of timing error up to less than 1s / mon. This level of performance, combined with its price of no more than 1-3 yuan, has a very high price performance ratio. In this project, the main function of RTC clock chip is to output the accurate Beijing time and date. In the production of this high-performance clock chip, Dallas company considered that in order to make the user drive the device as simple as possible, so in the aspect of appearance, it designed it
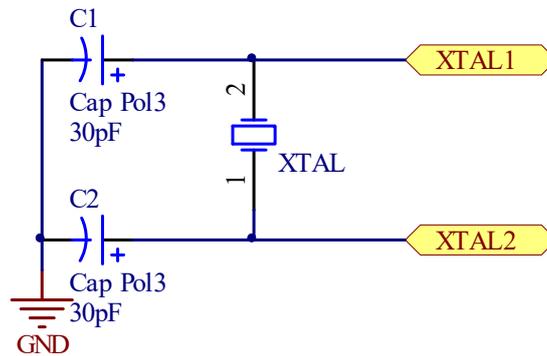
into 8-pin double row in-line package.



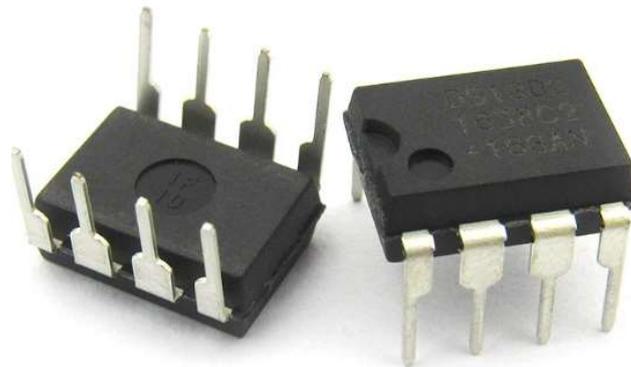Figure 3 Design of crystal oscillator circuit



Figure 4 Real picture of RTC clock chip

The main function of Beijing time timing circuit is to automatically generate time data. The circuit schematic diagram of DS1302 real-time clock chip is shown in Figure 5, which is composed of + 5V voltage power supply circuit and three wire serial single-chip pin drive circuit. In terms of module power supply of RTC chip, this device can be found after consulting the data files provided by the device manufacturer. With the characteristics of wide voltage input, it can work stably in the DC voltage range of + 2.5-5v, which is mainly due to a high-performance voltage stabilizing module inside it, which can reduce and stabilize the DC voltage input by external power supply and effectively filter the AC interference components carried in it. Because the bus automatic station announcer system designed in this subject adopts + 5V voltage For power supply, it can be directly applied to pin 1 of DS1302 real-time clock chip, connected according to the power supply method in the figure below, and grounded pin 4. In terms of the design of the pin driving circuit of the three wire serial single chip microcomputer, since pin 5-7 of this clock chip device is its control pin, the system needs to allocate three different GPIO pins to connect with the RTC clock chip device, and the drive can be completed after the connection according to the schematic diagram in the figure below.
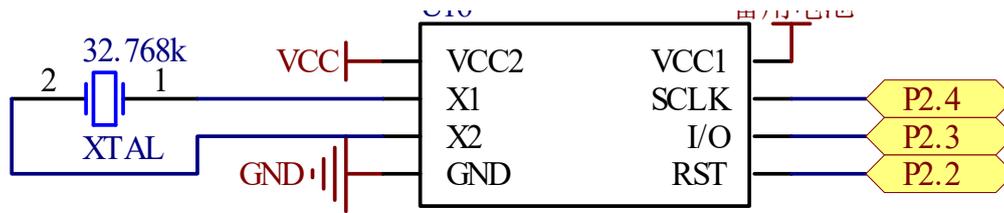
Figure 5 Timing circuit design of station reporting system

In the initial design goal, because the bus automatic station announcer system needs to have the function of human voice broadcast, so this topic must consider to configure a module circuit which can realize the function of voice broadcast parameters outside the STC89C51 single-chip microcomputer. After consulting the data of various commonly used parameter realization human voice broadcast modules on the market, it is found that the voice broadcast chip is A very good choice. Many excellent features of sc8035 voice chip are mainly due to the high-density integration of bus interface, filter circuit, digital resolver, memory and master controller, etc. in the chip, users only need to carry out simple command driven control to make it show high-performance broadcast parameter function. It can be found from the appearance of sc8035 voice chip in Figure 6 that this LCD screen provides a total of 8 pins for the user, which is very convenient for the user in terms of PCB layout or plug-in of components, and these excellent features are also the main factors that voice broadcast chip still attracts many MCU developers after many years. In terms of power consumption, it can be known that it does not exceed 55MW in normal operation through extensive reference to Internet and library data. In addition, its + 5V power supply voltage and control level are also suitable for the application of the bus automatic station announcement system.



Figure 6 Physical figure of sc8035 voice broadcast chip

In order to realize the function of real person broadcast of parameters through sc8035 voice broadcast chip, the device needs to be designed in two layers of hardware and software, including the peripheral circuit of the device and the bottom driver. In this part, the hardware peripheral circuit of the voice chip is designed firstly, according to the relevant data. It is recommended to design the circuit topology of voice broadcast chip as shown in Figure 7. This device provides 8 pins with different functions. According to the official data, the peripheral circuit of sc8035 voice broadcast chip is relatively simple. It only needs to supply power and then connect its control pin with the GPIO pin of STC89C51 single chip microcomputer. It can be seen that the overall design idea of the circuit is relatively clear. According to the power supply voltage

parameters in the official data, the + 5V DC voltage used to supply power to the MCU and other chips is directly used for power supply, and the voltage is applied to pin 6. In terms of the connection mode with the single-chip microcomputer, it is still implemented according to the method of official data. In order to realize the demand of the bus automatic station announcer system for the voice broadcast function, this part will start to design the internal function schematic diagram of the sc8035 voice broadcast chip, mainly including the power supply mode of the chip and the connection relationship with the single-chip microcomputer, according to the circuit in the diagram. As shown in the schematic diagram, this chip has 8 different functional pins, and its peripheral circuit structure is relatively fixed. First, a small capacitor needs to be connected to its vreg pin, and then + 5V DC voltage is applied to its VCC pin to realize power supply. Then, the single-chip connection circuit is designed. In this project, the RST and SDA of sc8035 chip will be connected through P1.6 and P1.5 pins respectively. The communication between STC89C51 and two pins can be realized.
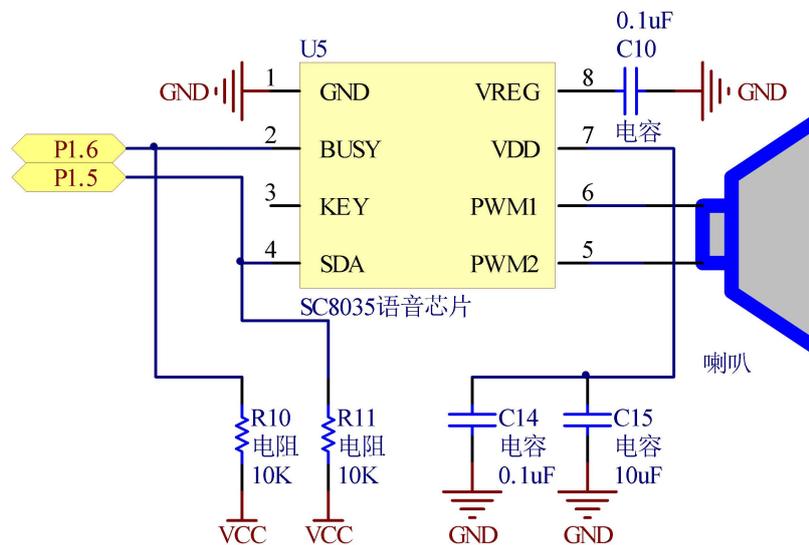


Figure 7 Circuit design of live voice broadcast

Several other important parameters of LCD1602 dot matrix screen are introduced. This device can be flexibly controlled by STC89C51 single chip microcomputer. In addition, it needs to consume 11 pins of STC89C51 single chip microcomputer in this system. Considering the rich GPIO pin resources of STC89C51 single chip microcomputer and the connection of other functional modules to the pins of single chip microcomputer, its package can meet the requirements of the company. To meet the requirements of automatic station reporting system. Through the investigation of the most commonly used types of display screens in the market, it can be found that OLED and LCD1602 are the two most commonly used liquid crystal displays. After a simple comparison, it can be found that the differences between the two devices are relatively obvious. The LCD1602 display shown in Figure 8 is slightly better in terms of both the external

volume and the internal functional parameters. However, if the performance and purchase cost of both are comprehensively analyzed, the cost performance of LCD1602 LCD screen is much higher than that of the former. Considering the limited time and funds of this graduation project, if LCD1602 LCD device is implanted into the bus automatic station reporting system, it can ensure the high-definition LCD of the system. Therefore, the LCD1602 LCD screen in the figure below is finally used to realize the display function of important parameters.



Figure 8 Physical figure of LCD1602 LCD module

The expected design goal of this project includes the display function of important parameters. Therefore, LCD1602 LCD screen is selected to realize the function of this project. This function is mainly realized through the GPIO pin of STC89C51 single chip microcomputer to output high and low level data flow and send it to LCD1602 display to work on the internal circuit of the device. The design of hardware peripheral circuit will determine the software code is Whether it can be successfully transmitted between STC89C51 and LCD1602 LCD screen, so as to achieve high-quality display parameter function. The key point of this part of design is that the system can provide LCD1602 LCD screen with high-quality power supply with appropriate power supply voltage and input current, so that LCD1602 lattice screen cannot be affected by the power supply under adverse circumstances. In addition, the system can provide LCD1602 LCD screen with high-quality power supply with appropriate power supply voltage and input current. On the one hand, it is also necessary to connect the external data input and output pins of LCD1602 display device to the GPIO pins of STC89C51 single chip microcomputer according to the connection relationship in Figure 9, so as to basically complete the design of LCD1602 LCD hardware peripheral circuit, on this basis, the following will design the software code, and finally realize the function of display parameters.
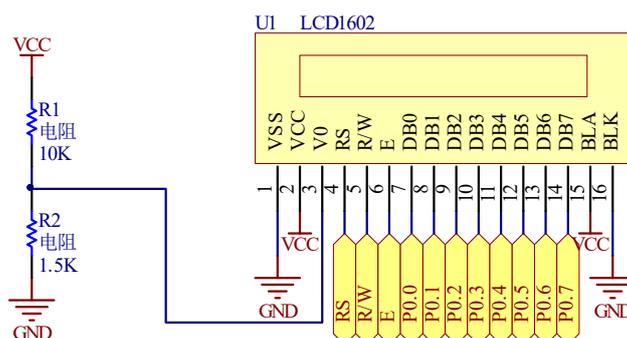
Figure 9 LCD circuit design of station announcement device

In this project, four mechanical keys are used to construct the key circuit, as shown in Figure 10. S1-S3 are used to broadcast platform information, S4 is used to enter the time setting mode. In the time setting mode, S2 and S2 are used to add and subtract the time to be set respectively. These four keys are respectively connected to the four pins p1.0-p1.3 of the single chip microcomputer.
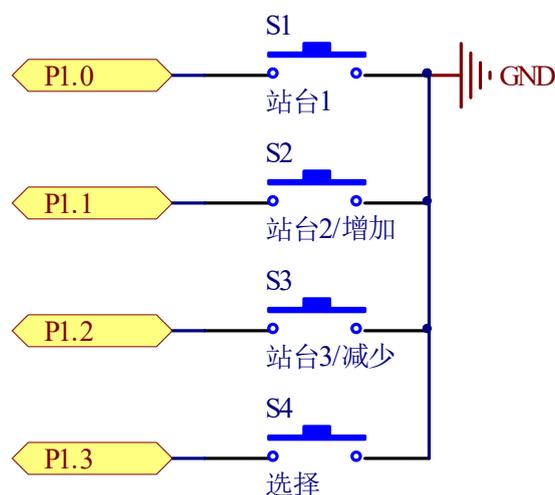


Figure 10 Schematic diagram of key circuit

## 3. Conclusion

The system has been tested repeatedly under many environmental conditions, and shows a very high stability in the operation process, and can respond quickly according to the operation of the tester. This is mainly due to the above excellent hardware circuit and software code design results. In the hardware system, the whole bus automatic stop reporter system is divided into STC8. 9c51 single chip microcomputer minimum system, LCD1602 liquid crystal display circuit, DS1302 timing circuit and human voice broadcast circuit, etc., and in the aspect of software code, they are divided into main program and multiple subprograms. Through this design method, the design difficulty of bus automatic station announcer system is reduced, and each functional module is designed and optimized separately.

## Acknowledgements

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