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Simulation Test of Electronic Door Lock and Doorbell Circuit Based on 74 Series Chip

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Abstract: In this paper, the electronic combination lock circuit is simulated and tested using Multisim software. The paper begins by presenting the overall circuit. After that, the individual modules are tested separately, which include the password input module, the timing module, the display module and the alarm module. The test results were as expected and the tests passed. Finally, the paper makes suggestions for improvements to this system.

1. Introduction

This paper uses Mulitisim software to simulate and test the doorbell system. The first is the principle and structure of this system to do a simple description. Then the module test was carried out.

2. Circuit Design

The main function of this design is the function of 8 bit binary password comparison. When the password is entered correctly, the lock is unlocked and the doorbell rings. When the password is entered incorrectly, the system will alarm.

The circuit diagram of the overall system is shown in Figure 1. For this circuit, there are many design schemes, this paper will be based on the design principle of medium scale integrated circuit circuit design and use Multisim software simulation test.

This design mainly uses two four digit numerical comparator 74LS85 cascade into eight digit numerical comparator, carries on the password comparison. Two pieces of integrated bidirectional shift register 74194 are cascaded into an eight-bit data register to store the input eight-digit password. The 555 timer is used to form a multivibrator to output square waves with different duty cycles. The clock circuit is designed to form a monostable trigger to output a 10s steady-state waveform. Use two asynchronous decimal counter 74LS290 cascade into counting 100 counters, design timing circuit. Use 74LS48 and connect digital tube to display the number of seconds of timer.

This part aims at the circuit designed above. The overall circuit diagram is shown in Figure 1.

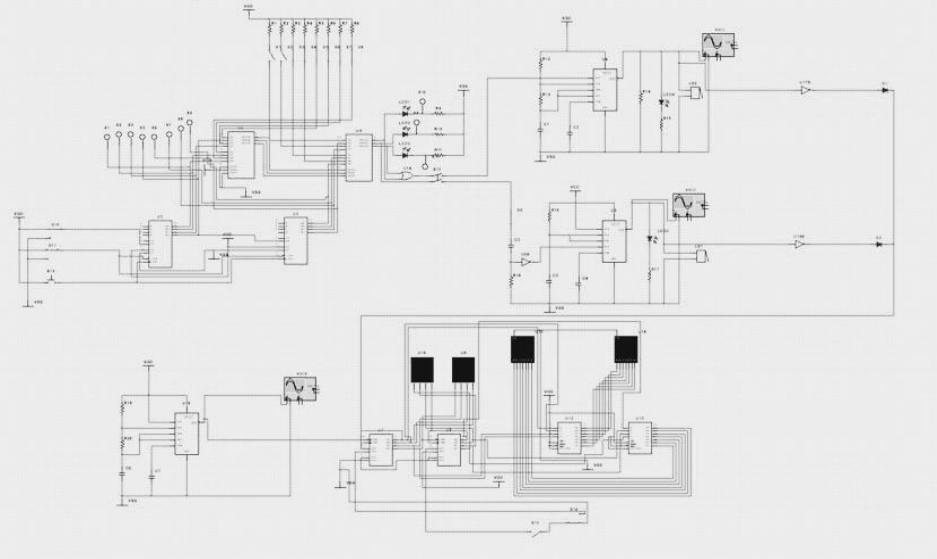

Fig.1 Simulation of the Total Circuit Diagram

3. Simulation and Debugging Results

This part aims at the circuit designed above, uses Multisim software to carry on the circuit simulation verification. The following paper will verify each part of the circuit module of this design separately.

3.1 Password Input Simulation Module

The password input simulation module circuit is shown in Figure 2. The original password is input from the A terminal of the numerical comparator, and the input password is input from the B terminal of the comparator. In order to make the result more intuitive, indicators are added in the place of password input and result output. The three indicators connected with pin 4, 5 and 6 at the output end respectively represent A>B,A=B,A<B.

When the original password is 10111111 and the input password is 00000000, obviously, the password is incorrect and the original password is larger than the input password. Therefore, the indicator connecting pin 4 is on and the LED is on.

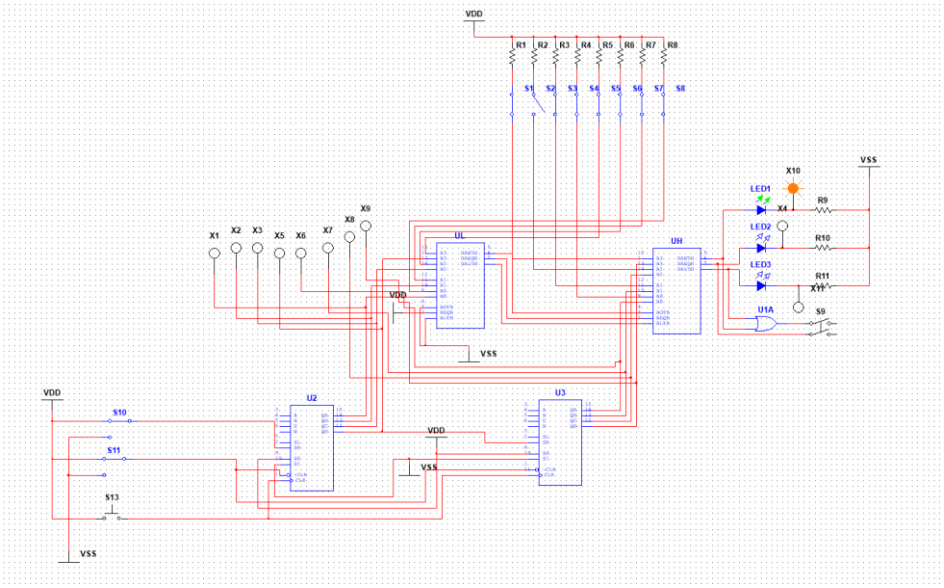

Fig.2 Simulation Diagram of Incorrect Password Input

3.2 The Clock Module

The timing module first includes a multivibrator composed of 555 timer, and then a display module composed of seven codes and digital tubes. This part simulates these two small modules respectively.

The first is the multivibrator module composed of 555 timer. According to the principle described above, the output waveform should be a waveform with a period of 1Hz and a duty cycle of 53%. The simulation results are in agreement with the theoretical ones.

3.3 Display Module

Next comes a display module consisting of seven segments of code and a digital tube. In order to make the result more obvious, in this module, the design adds two more nibbles to record the signal output from the counter chip. This module needs to display the function is to convert the output 8-bit binary signal into decimal numbers that are easy for people to see intuitively, and display them using digital tubes. The simulation results are shown in Figure 3. The display of the two nixie tubes on the left is consistent with the display of the two nixie tubes on the right and meets the requirements.

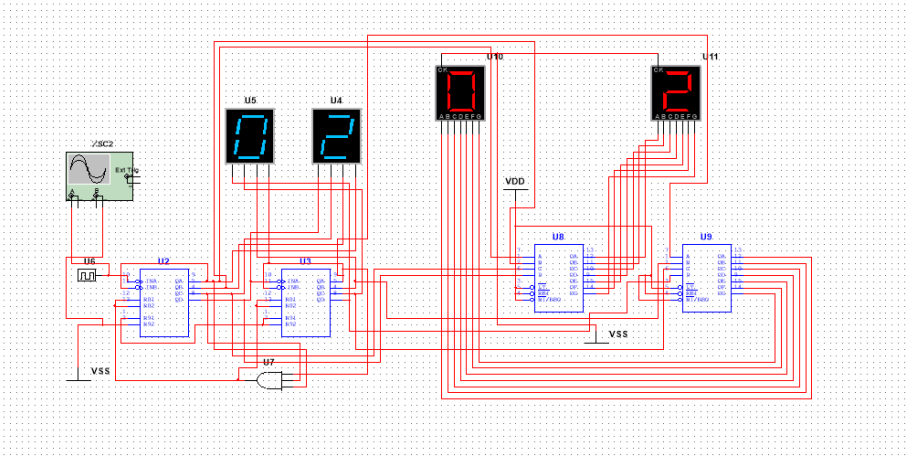

Fig.3 Simulation Results of Timing Module

3.4 The Doorbell Module

When the S1 analog password is entered correctly, the doorbell system will be input by a high level signal, triggering the module to turn over to the steady state, and the LED indicator turns green, indicating that the password is correct, and the buzzer simulates the sound of the doorbell. The simulation results show that the output waveform maintains a high level of 10s, which meets the requirements of the circuit and passes the simulation.

3.5 Alarm Module

Simulation circuit of alarm module is shown in Figure 4. When the S1 analog password is incorrectly input, the high level triggers the alarm module, and the LED indicator lights up, and the buzzer represents the alarm ring.

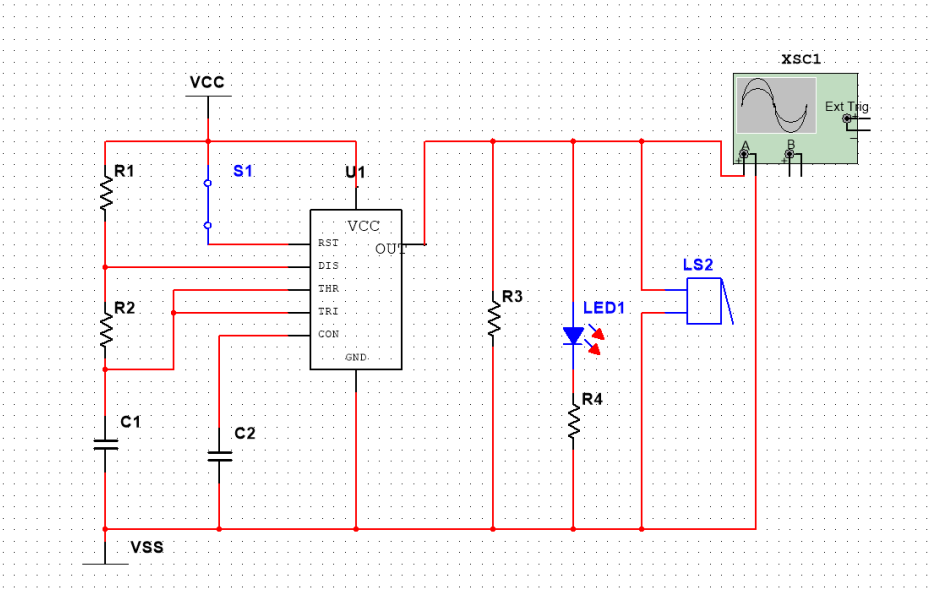

Fig.4 Simulation Circuit of Alarm Module

The simulation output waveform is shown in Figure 5. It can be seen that the LED indicator turns red, and the output waveform of this circuit is 15s high level, and the output waveform of 3-second low level alternation meets the requirements of the circuit, and the simulation passes.

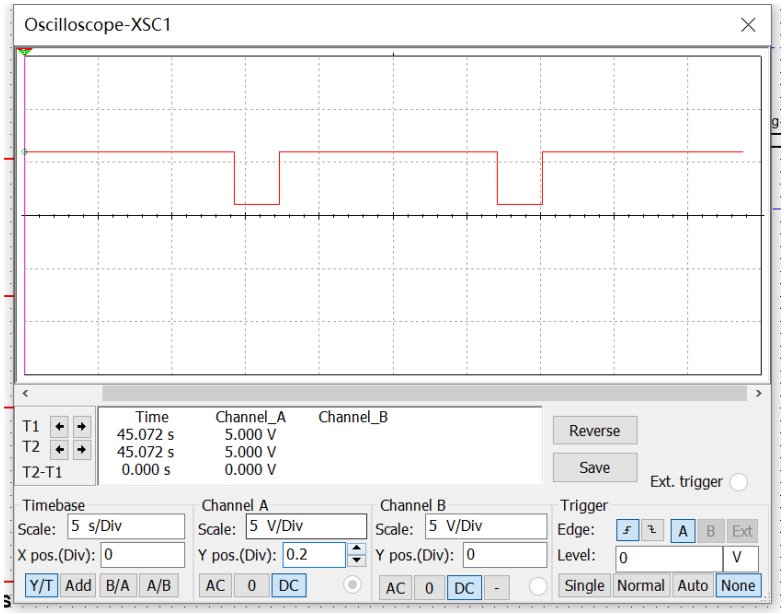

Fig. 5 Simulation Results of Timing Module

3.6 Sound Module

Buzzers are used in both alarm module and doorbell module, as shown in Figure 1. The simulation results show that when the signal input to the buzzer is high, the buzzer starts to ring.

It should be noted that the working voltage of the buzzer should not be the working voltage provided by the circuit, which will make the buzzer unable to work. In the simulation, the working voltage of the buzzer can be appropriately reduced according to the needs, or the input signal can be amplified by triode.

4. Conclusions

The design of electronic door lock and doorbell circuit simulation test. The function design and principle of each module are simply described. The next step of this design is as follows:

(1) The next step is to implement the four-digit decimal as the password to improve the security of the password.

(2) The next step is to implement the input module of voice broadcast. When the password is entered correctly or incorrectly, the voice broadcast will prompt whether the password is entered correctly, making the circuit more intelligent.

References

[1] XIE Song-min. Design of remote virtual laboratory based on LabVIEW and Multisim electronic Circuit [D]. Hunan Normal University, 2015.

[2] Yang Rui, Wang Xiaoyan, Yang Ting. Construction of Electrical and Electronic Laboratory Based on Multisim Virtual Simulation Technology [J]. Experimental technology and management, 2015, 32(10):129-131.

[3] FU Yang. Application of Multisim Simulation in electrical and electronic experiment [J]. Laboratory research & exploration, 2011, 30(04):120-122+126.