Research on the Application of Jitter Elimination Circuit and Trigger Teaching

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Abstract: Many courses of electronic specialty are theoretical and abstract, and students are generally not interested in theory, even afraid of difficulties. Hardware and software are generally used to eliminate jitter. Hardware jitter elimination is realized by the principle of circuit filtering. However, for the sake of saving hardware resources and being easy to modify, software is often used to realize hardware circuit. According to the learning situation of vocational schools, taking the application of jitter elimination circuit and trigger teaching as an example, this paper explains the teaching methods of digital circuit course in detail, explains the methods and means of the whole teaching process in detail, and explains the key points and difficulties. I hope it can play a certain role in guiding the teaching of the whole course.

1. Introduction

Digital circuit, as a professional basic course of applied electronics, plays a very important role. It is a follow-up course of electrician foundation. Only by learning these two professional basic courses, digital circuit and analog circuit, can we learn professional courses better. The traditional teaching mode is that teachers tell students to listen and teachers do students to see. This kind of classroom atmosphere is dull and boring, and students' learning efficiency is low. This teaching mode no longer meets the needs of teaching development [1].

Flip-flop is the basic unit of sequential logic circuit, which is obviously different from combinational circuit in that the output of sequential circuit is not only related to the input of circuit, but also related to the state of circuit. In essence, flip-flops are composed of gate circuits in the same structure as combinational logic circuits [2]. The author has been teaching digital circuit and logic design for many years, and found that students have just come into contact with sequential circuits, so it is difficult to change from the analysis and design method of combinational circuits to the analysis and design method of sequential logic circuits. This paper studies the application of jitter elimination circuit and flip-flop teaching.

2. Circuit Principle of Eliminating Jitter by Keys

Usually, the keys used are mechanical contact switches, because the mechanical contacts have elastic action. When the key is pressed or released, a series of key jitters will inevitably occur at the moment when the contacts are closed and opened. In order to make the key jitter elimination circuit module simple; The portability is good. Here, the function of eliminating jitter by keys is realized by counter. The voltage jitter will appear at the moment when the contact is closed or opened, which will cause false triggering if it is not processed in practical application [3]. There is no problem when breaking contact, but conversely, due to the reaction of spring force, it will leave the contact point at the moment of contact, and then it can be stabilized after several jumps. If the jitter is not filtered out, the key will be misread many times at the edge of the read signal, which will lead to misoperation of the circuit. In order to ensure that the key circuit only responds correctly once, it is necessary to use the key jitter elimination circuit.

3. Several Design Methods of Key Jitter Elimination Circuit

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3.1. Counter-based Key Jitter Elimination Circuit

It is realized by using counter, that is, adopting the method of delay. Set the counting clock pulse correctly first. When it is judged that there is a pulse and it is a rising edge, the counter starts counting, and when the counter is full, the state of the key is output. The advantage of this scheme is that the switch pressing and the output time are basically simultaneous, and the output pulse width is also determined and adjustable, so it is suitable for occasions with high requirements for working speed or timing coordination. Keyed monopulse generator uses circuit to solve the problem of eliminating key jitter and get stable signal. Because of the elastic effect of mechanical contact keys, there is a dithering process at the moment when the keys are pressed and released, which makes the useful pulse signal appear dithering and produces dithering noise [4]. The pulse width of a single pulse is the same as the clock cycle, thus realizing equal pulse width. And delayed by half a clock cycle to make the output pulse correspond to the clock cycle, thus realizing phase adjustment. If the input is less than 8 bits or needs to be re-input, the last result is cancelled, and if the input result is determined to be correct, the 8-bit signal is saved and output.

3.2. Key Jitter Elimination Circuit based on RS Trigger

The jitter elimination circuit controls the counter to work for one cycle (N+ 1 states), and outputs "1" only when the counter is 0. Chain control facilities are designed for the circuit. The input above the threshold voltage is high, and the input below the threshold voltage is low. Among them, the key shaking time is related to the mechanical characteristics of keys, which is generally 5 ~ 10 ms, and the steady-state pulse width of key closure is determined by the operator's key action, which is generally several tenths of a second. The pressing time is longer than 50ms [5]. According to this convention, we think that the pressing time is less than 50ms as jitter signal, and the pressing time is more than 50ms as key signal. Because the time width of the signal directly output by the flip-flop may be too long, a synchronization circuit is connected after the flip-flop to ensure that the output signal only occupies the width of one clock cycle. The key to apply this method to filter jitter is to determine the sampling clock frequency. However, if there is no need to use the edge time of input pulse in use, it will not bring any problem even if noise is generated.

3.3. Key Jitter Elimination Circuit based on State Machine

The jitter elimination circuit of state model is described and realized by the design method of finite state machine. The state machine has three states: S0, S1 and S2 [6]. In S0 state, the key out output is at a low level, and the key input signal is sampled at the frequency of CLK clock signal. If key in =' 0', it will remain in S0 state and continue to sample the key input signal. In addition, the time from the stable pressing of the switch to the rising edge of the output waveform is definitely adjustable, so it can also meet certain timing coordination. In this way, the same content is actually nibbled twice, so the recovered content is exactly the same as the content at the interruption time. Therefore, when the sampled input signal is at high level, that is, key _ I =' 1', s1 is turned again to eliminate jitter delay; when the delay is over, s2 is turned to judge the key state at this time; when the sampled input signal is at low level, s0 is returned, and the operation of pressing and releasing the key once is completed at this time.

4. Trigger Teaching

4.1. Analyze and Master the Working Principle and Action Characteristics of Trigger in Essence

Generally, when you start to learn flip-flops, you have just finished learning combinational logic circuits, so you should guide students to pay attention to the differences and connections between combinational logic circuits and sequential logic circuits in teaching. The functional representation method of combinational logic circuit corresponds to the functional representation method of sequential circuit. Taking "Design of Divided-by-Four Circuit" as the carrier, through design and verification of divided-by-two circuit-finding problems and explaining them-finding problems and

explaining them, students are guided to explore the application of triggers, and with interactive means such as group discussion, the key points are highlighted, the difficulties are decomposed, and the integrated teaching of theory and practice with students as the main body and teachers as the leading factor is realized [7]. First, the teacher demonstrates the working process of a D trigger, so that students have a general understanding of the D trigger; Secondly, let students connect wires on the digital learning platform, test the logic function of D trigger and fill in the truth table; Then let the students describe and summarize the logical function of D trigger. By designing a simple circuit, we can deepen our understanding of flip-flops. It also trains students' ability to solve practical problems by using their knowledge.

In the teaching process, the classroom introduction of each class is carried out through a demonstration of interesting circuits, which attracts students' attention five minutes before the class where students concentrate their energy most. By asking questions, students feel that the content to be learned in this class is interesting, which can generate internal motivation for learning and help to improve students' interest in learning. Choose the required circuits and design them. Students build circuits and test whether they are correct, so that students can obtain intuitive perceptual cognition and reduce the difficulty of abstract thinking. According to the truth table of D flip-flop, it can be found that D flip-flop has the functions of setting 0 and setting 1, and the output signal is the same as the input signal. In addition, it also has set and reset functions, in which S is the set terminal and R is the reset terminal, both of which are active at high level. Mastering the working principle and logic function of triggers can be said to be directly related to the teaching effect of triggers. Therefore, students must be the main body in teaching, and students should be guided to think and summarize themselves, so as to deepen their understanding and mastery.

4.2. Grasp the Internal Relationship between Various Triggers from the Structure

Structurally, flip-flops are divided into basic RS flip-flops, synchronous RS flip-flops (Figure 1), master-slave flip-flops and edge flip-flops, etc. Different circuit structure forms lead to different action characteristics. Teachers throw out guiding questions, students focus on problems, use books in their hands for autonomous learning, exchange and discussion, and finally teachers summarize and supplement and explain new knowledge. Let the students connect the power supply to observe the effect of the circuit. When the button is pressed normally, the LED lights up and the buzzer sounds after a certain period of time. By changing the resistance of the adjustable resistor, it can be found that the timing time also changes. The change of flip-flop state is determined by clock pulse and input signal. Clock pulse determines the time (when) of flip-flop state transition, and input signal determines the direction (how) of flip-flop state transition. This flip-flop with clock pulse control is called "clock control flip-flop". The output signal will not change during the duration of the level, so the time when the effective level starts can be used as the dividing point between the current state and the secondary state of the flip-flop. In the pulse trigger mode, the change of the output signal occurs at the end of the effective pulse, so this time is the dividing point between the current state and the secondary state of the trigger.

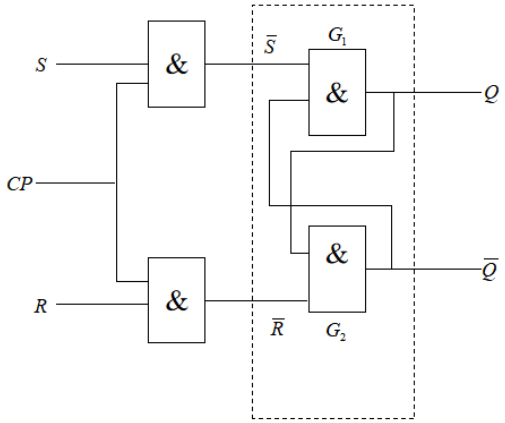

Figure 1 Synchronous RS flip-flop

T-flip-flop can be formed by connecting the J and K inputs of J-K flip-flop, and using T to represent the connected inputs. For example, T flip-flop takes the hold and flip functions of JK flip-flop, while T flip-flop only takes its flip function, while RS flip-flop takes its set 0, set 1 and hold functions. Therefore, there is no fixed relationship between the circuit structure and function of flip-flops. Among them, it focuses on the master-slave JK trigger, which is used in class. This circuit is a two-color bi-directional water lamp circuit. The JK trigger is an important component for controlling the water lamp to flow from left to right and from right to left. Next, enter the knowledge points of JK trigger. J-K flip-flop has the most comprehensive functions, while the other three flip-flops take part of them. It can be seen that the four flip-flops are inextricably linked. As long as an appropriate external control circuit is added, the internal structure of the flip-flop can be changed without changing.

5. Conclusion

In teaching, if students are simply instilled with theory, they are not interested and can hardly accept knowledge. However, changing teaching methods, taking tasks as the guide, grasping key points, decomposing difficulties, implementing integrated teaching of theory and practice, integrating knowledge and skills, and learning while doing can effectively reduce the difficulty of teaching. There are many schemes to eliminate jitter, and the programming forms are various. Several specific circuits introduced in this paper only give students an enlightening guide and open up ideas. A key point in flip-flop teaching is to make students understand that the state of flip-flop changes only when the trigger signal (clock pulse) is valid, which establishes the position of flip-flop as the basic unit of sequential circuit. It is necessary to start with the basic logic circuit structure, contact and compare combinational logic circuits, and understand the working principle, logic functions and internal relations of each flip-flop, so as to lay a good foundation for the subsequent study of sequential logic circuits.

References

[1] Yin, Chunyan. Some thoughts on simplification of trigger teaching. Popular Science (Science Education), no. 004, pp. 123-125, 2016.

[2] Zhong, Bin., Zeng, Chao. The application of Multisim simulation in the teaching reform of digital and electronic experiments. Contemporary Educational Theory and Practice, vol. 76, no. 04, pp. 64-67, 2016.

[3] Cai, Chungui., Wang, Dengfeng., Zhong, Xingwang., et al. Relative time delay calibration circuit based on Schmitt trigger. Space Electronics Technology, vol. 016, no. 003, pp. 72-75, 2019.

[4] Jiang, Bo., Tian, Hui. Design of adaptive signal processing circuit for flame trigger. Computer Measurement and Control, vol. 27, no. 03, pp. 168-172, 2019.

[5] Cui, Jianguo., Ning, Yongxiang. Special switch intelligent delay device based on Schmitt trigger. Industrial Technology Innovation, vol. 005, no. 002, pp. 29-32, 2018.

[6] Qi, Yinian., Li, Yadong., He, Bo. Design of closed-loop system of three-phase rectifier circuit with integrated trigger control. Huadian Technology, vol. 40, no. 004, pp. 11-15, 2018.

[7] Jiang, Xiaoyun., Wang, Tianbao., Zhang, Yongli. Design of a new generation of weather radar switch and trigger assembly quick maintenance system. Computer Measurement and Control, vol. 026, no. 010, pp. 49-52,75, 2018.