Design and Realization of a LAN Connectivity Test Circuit

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Abstract. The simple network cable tester can only test one network cable at a time. When multiple network lines need to be tested, there are problems such as a long time, low accuracy, proof efficiency, and unable to display visually. A multi-network test circuit is developed and designed based on the principle of network cable testing on this paper. The principle of the simple network cable tester is briefly analyzed. The overall design idea, circuit design, and working principle of the LAN connectivity test circuit are explained in detail. The circuit characteristics are summarized. The actual application verification is performed during the management and maintenance of the unit LAN. The application results show that: this circuit has the characteristics of stable operation, simple operation, safety and reliability, convenient maintenance, and intuitive display. It improves the speed of network cable testing, increases the visual display of test results, improves the efficiency of network cable testing, and has achieved good application results.

1. Introduction

Connectivity refers to a topological nature of cyberspace or collections. Intuitively speaking, connectivity is connected without interruption [1]. Connectivity analysis is to analyze whether two points are connected according to the specified starting and ending nodes; or to determine whether multiple points are communicating with each other according to the specified multiple points. In computer science, connectivity analysis mainly analyzes the connectivity between multiple points in a network. With the popularization of the network, network cables are located in every corner of daily life. It is the most important part of network wiring. Therefore, network cables are one of the essential devices for connecting to the network. The most direct impact is related to network continuity and network communication quality. When the computer cannot connect to the Internet, the network cable is often the first object of suspicion. The first response is "Is the network cable broken and caused a failure?" Generally speaking, there are three main problems caused by network cable failures: connection, performance, and continuity. So how to judge whether the network cable is normal? Generally, use a network cable tester to determine whether the network cable is normal. Similarly, in the network cabling project of the local area network, a large number of network cables need to be laid, and each of them needs to be tested, that is, the network cable connectivity test[2]. It is often necessary to use a network cable tester to check the connection of the network cable and the sequence of the cables. When the network cable, especially the 8-core cable, is inserted, it is troublesome to determine whether the connection is correct. Therefore, if you can test the quality of the network cable in advance and complete the connectivity test of the network cable in advance, the network efficiency will be greatly improved. Currently, the network cable testers on the market can only test one network cable at a time, and the test efficiency is low. When more than one network cable is needed, the test
time will be greatly increased. In view of the above problems, a test circuit capable of testing multiple network cables at a time is designed in this paper, which aims to provide an efficient method for testing network cables, which greatly improves the efficiency of network cable testing.

2. Principle analysis of simple network cable tester

The simple network cable tester is relatively simple. The test content item is only a wiring diagram. The basic principle is to determine the connectivity of the network cable by sending pulses and checking whether the corresponding indicator lights up during the test of the network cable. 8 LEDs when the network cable wiring diagram is correct will light up one by one in accordance with the rhythm of sending pulses [3]. When the network cable is normal, the LED indicator is green. If the network cable is open or disconnected, the corresponding indicator is off, that is, the LED indicator is off. If there is an error in the wire sequence, the LED indicator will also be wrong and flickering [4]. If a short-circuit fault occurs, there will be multiple LED indicators on at the same time. According to the lighting sequence of the LED indicator, you can determine the connection status of the network cable, that is, determine the connectivity of the network cable.

This testing instrument has serious shortcomings. The first is the slow test speed. For example, to check an 8-core network cable, it is necessary to wait for the tester to send 8 pulses in order to complete a test. The test pulse cannot be sent too fast, and the eyes cannot judge whether the indicator light is on or off [3]. Secondly, if there is an error in the line order, the error is that it is difficult to accurately judge the line, because the wrong line order causes the test lamp to blink in a disordered sequence, and it is difficult for people with insufficient engineering experience to see that within one or two test cycles. Which lines have a wrong line order.

3. LAN connectivity test circuit design

3.1 Overall design ideas

According to the principle of network cable testing, a test circuit for multiple network cables is developed and designed to accurately determine the continuity and sequence of network cables, and the test results are displayed intuitively through the LCD display, especially when the network cable to be tested is open, but the quality. When it is not good, the operator can also judge the communication quality of the network cable from the light emitting intensity of the light emitting diode. In order to reduce the influence of human factors on the test result, the signal receiving circuit transmits 8 channels of signals to the wireless signal transmitting circuit at the same time. The circuit sends the signals received at each input to the signal processing circuit.

3.2 Multi-network cable connectivity test circuit design

This circuit includes a pulse signal source LM555CN [5], a serial-to-parallel conversion circuit, a signal transmitting circuit, a signal receiving circuit, light emitting diodes LED1 to LED8, a wireless signal transmitting circuit, a signal processor, and an LCD display screen [6]. As shown in Figure 1.
Pulse signal source LM555CN is a highly stable controller / can generate accurate timing pulses, with powerful functions, flexible use, wide application range [5], and low power consumption, small power supply voltage, high input impedance, low output power. Features can be used to generate time delay and a variety of pulse signals, is widely used in various electronic products.

The output terminal of the pulse signal source LM555CN is connected to the CLK input terminal of the serial-to-parallel conversion circuit. The output terminals Q1 to Q8 of the serial-to-parallel conversion circuit are connected to the input terminals I1 to I8 of the signal transmitting circuit RJ45. The terminals Q1 to Q8 are connected to the signal receiving circuit through eight network cables to be tested, that is, the eight input terminals of another RJ45 chip, and the eight output terminals of the signal receiving circuit are correspondingly grounded through the light emitting diodes LED1 to LED8 [6].

The eight output ends of the signal receiving circuit also correspond to the eight input ends of the wireless signal transmitting circuit; the wireless signal transmitting circuit has a wireless signal connection with the signal processor, and the signal processor has a signal connection with the display screen.

The adopted wireless signal transmission circuit supports Bluetooth communication, and the signal processor also has Bluetooth communication function. The serial-to-parallel conversion circuit is implemented with a decimal counter.

3.3 Working principle
The specific working relationship of this circuit and the signal connection between each component are as follows:

(1) The pulse signal source LM555CN is powered to work and generates rectangular pulses. The rectangular pulses are input to the CLK terminal of the decimal counter. At this time, the VCC terminal of the decimal counter is connected to the power supply and the GND terminal is grounded, the decimal counter output Q1~Q8 in turn cycle high level. When one output terminal outputs high level, the other output terminals are low level.

(2) The signal transmitting circuit outputs the signals received by its 8 input terminals to its 8 output terminals, and the 8 signals are correspondingly transmitted to the 8 input terminals of the signal receiving circuit through 8 network cables to be tested. The receiving circuit also transmits the
signals received at the 8 input terminals to its 8 output terminals. In this circuit, the cathode of the light emitting diode is grounded, so the light emitting diode at the output terminal corresponding to the output high level of the signal receiving circuit will be turned on. Lights up, indicating that the network cable to be tested is connected. The 8 outputs of the serial-to-parallel conversion circuit appear high in order, thereby completing the test of 8 network cables in order.

(3) When the network cable to be tested is open, but the quality is not good, the light of the corresponding LED in the test path is weak, so the operator can also judge the communication quality of the network cable from the light-emitting strength of the LED [6].

(4) In order to reduce the influence of human factors on the test results, the signal receiving circuit transmits 8 channels of signals to the wireless signal transmitting circuit at the same time, and the wireless signal transmitting circuit sends the signals received by each input terminal to the signal processing circuit. For example, when the signal at the second input terminal of the wireless signal transmitting circuit is high level, the signal form sent to the signal processing circuit may be a serial data, such as "01000000", and the signal processing circuit may determine the high voltage The serial number of the input terminal of the corresponding wireless signal sending circuit, so the serial number is 2 at this moment, and transmitted to the display screen. When the display shows 2, the operator can know that the second network cable is connected [4]. At the same time, the signal processing circuit is also used to compare the high level with the standard signal amplitude and transmit the comparison result to the display screen for display. If the result is less then the communication quality of the second network cable is considered poor.

3.4 Main features

(1) A large number. This circuit can test multiple network cables at a time, and at the same time test up to 8 network cables at the same time, which overcomes the problem that the current Internet cable testers can only test one network cable at a time.

(2) High efficiency. This circuit can test multiple network cables at one time, reducing the test time of multiple network cables and improving the efficiency of network cable testing.

(3) The results are displayed visually. This circuit can judge the quality of the network cable and the continuity according to the light-emitting state of the light-emitting diode, and can also directly display the test results on the display screen for the operator's reference.

(4) Bluetooth communication technology. This circuit uses Bluetooth communication technology to realize the wireless signal connection between the wireless signal sending circuit and the signal processor, which simplifies the connection relationship between the components.

(5) Easy operation

The design has a simple structure and provides a simple, practical, and convenient network cable test circuit, which is convenient for users to operate.

4. Conclusion

This article develops and designs a multi-network cable test circuit, which solves the problem that the current simple network cable tester can only test one network cable at a time. The multi-line test time is long, the test accuracy is low, the test efficiency is not high, and the visual display cannot be achieved. In order to accurately judge the continuity and sequence of the network cable, the test results are displayed visually. After the circuit design was completed, actual application verification was performed during the management and maintenance of the unit's local area network. The application shows that the circuit has the characteristics of stable operation, simple operation, safety and reliability, convenient maintenance, and intuitive display. It shortens the network line measurement time, improves the efficiency of network line testing, increases the display function, and achieves good application results.

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This project is a key project of testing technology. A network cable test circuit have been designed by the
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