Design and Simulation of Intelligent Switching Circuit for Danger Alarm lamp and Steering Lamp of Vehicle Based on Multisim

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Keywords: Danger alarm lamp, Steering Lamp, Switching Circuit, Simulation, Multisim, Vehicle

Abstract: In response to the interference between the danger alarm lamp and the steering lamp, intelligent switching circuit for dangerous alarm lamp and steering Lamp is designed, and the composition and principle of the circuit are analyzed. The characteristics of Multisim software are introduced. The designed circuit is simulated using Multisim software. The simulation results show that the circuit can realize the normal operation of dangerous alarm lamp and the steering Lamp separately, at the same time, when the danger alarm lamp is turned on, the steering lamp switch is turned on, and the steering information can be normally indicated, thereby the interference problem of the two is solved when they are opened at the same time. The circuit has simple structure, strong practicability, and strong application value.

1. Introduction

In automotive electrical systems, lighting and signalling systems are very important components. The steering lamps are mounted on the left and right sides of the front and rear of the vehicle. Light and dark appear alternately when the vehicle starts, turn, chang lanes or park on the side, to warn other vehicles and pedestrians, it plays a vital role in the safety of vehicle, in addition, the vehicle is also equipped with danger alarm lamps. When the vehicle temporarily stops at roadside, the danger alarm lampt is turned on, which enables other vehicles and pedestrians on the road to notice the existence of the vehicle and avoid unnecessary accidents[1][2].However, the steering lamps and the danger alarm lamp share a group of bulbs, When driving in special weather conditions such as dense fog and windy sand, the driver usually turns on the danger alarm lamp, but if it is necessary to turn or change lanes at this time, the driver operates the steering switch, but the actual situation is still alarm lamp working, which can easily bring incorrect warnings to passing vehicles, especially the rear vehicle, which can easily lead to traffic accidents. Therefore, it is very important to design a intelligent switching circuit of danger alarm lamps and steering Lamps for vehicle.

2. Introduction to Multisim Software

Multisim is a Windows-based simulation tool from National Instruments (NI) Ltd. for board-level analog and digital board design[3].It contains the graphical input of the circuit schematic, the circuit hardware description language input method, and has a wealth of simulation analysis capabilities. Engineers can use Multisim to interactively build schematics and simulate circuits and simulate to the circuit. Through Multisim and virtual instrumentation technology, PCB design engineers and electronics educators can complete an integrated design cycle from theory to schematic capture and simulation to prototyping and testing [4].

The circuits can be built, simulate analysis can be carry out using multisim software, and design and experiment is synchronous. It can be simulated at the same time as the design, which is convenient for modification and debugging [5]. In the process of simulation, the circuit components and test instruments are not consumed, the experiment speed is faster, and the experiment cost is saved.

  DOI: 10.25236/icbsis.2020.042

3. Design of Intelligent Switching Circuit

According to the current situation that the interference between the danger alarm lamp and the steering lamp with each other, Multisim is used to design a basic circuit of danger alarm lamp and the steering Lamp. The control chip is not added, the structure is simple, the cost is low, and it can realize mutual non-interference between them. At present, most vehicles on the market are driving. When the danger alarm lamp is turned on, the steering Lamp will not be displayed after turned on. The danger warning damp signal will be displayed preferentially, and the real-time dynamic information of the vehicle cannot be displayed normally [6]. The steering lamp circuit and danger alarm lamp circuit are the same circuit system. By adding a number of relays, a conversion circuit is designed, which is installed in the danger alarm lamp circuit, and danger alarm lamp is controlled by mean of the turn signal switch controlling the conversion circuit.

4. Basic Circuit Design

The basic circuit structure is relatively simple, and the wiring is relatively clear. Using Multisim, circuit design and wiring can optimize, design efficiency is improved, and design cost is reduced. Where, the steering lamps use LED , and that the LED light source replaces the traditional steering lampl source, which can increase the service life of the steering lamp and reduce pollution. The basic circuit is shown in Figure 1.

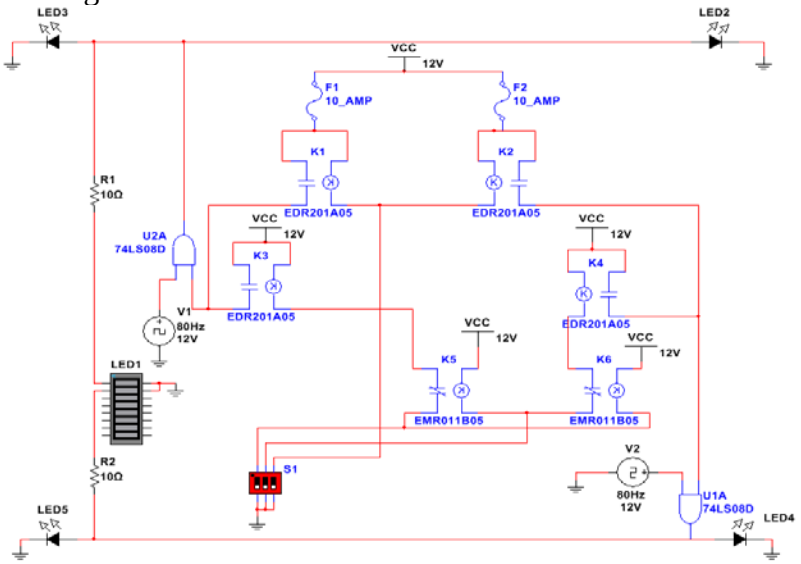

Fig. 1. Basic circuit

The steering lamp is replaced by four LED lights with an on-state current of 0.5A. The left steering lamp of the vehicle is indicated by LED2 and LED3, and the right steering lampl is indicated by LED4 and LED5. The relay in the circuit uses a dry reed relay, the normally open relay uses adry reed relay of the type EDR201A05, and the normally closed relay uses adry reed relay of the type EMR011B05, both of which are negative control logic. In the flash circuit, the flashing frequency of the steering lamp is determined by the counting clock pulse, the counting clock pulse frequency is set to 80 Hz, the two clock voltage sources adopt CLOCK-VOTAGE, the parameter is set to 80 Hz, the duty ratio is 50%, the amplitude value is 12V. Two diodes D1 and D2 are used in the conversion circuit. The danger alarm lamp switch and steering lamp switch in the vehicle are replaced by the dial switch DSWPK-3 in circuit diagram. In Fig. 1, from left to right, Key1, Key2, and Key3 are the left steering lamp switch, right steering switch and danger alarm lamp switch, respectively.

5. Overall Circuit Design

In Figure 2, the designed basic steering lamp circuit and the conversion circuit are combined to form a circuit that can achieve the purpose of preferentially displaying the steering lamp signal when the danger alarm lamp is turned on and the steering lamp is turned on at the same time. In the circuit diagram, the designed conversion circuit is mounted between the energization path of the danger alarm lamp circuit and the steering lamp switch. When the danger alarm lamp is turned on, the conversion circuit is in a power-off state, and only acts as a wire. When the vehicle turns, steering lamp required to work is needed to turn on, the energization and de-energization of the switching circuit is controlled by the steering lamp switch to control the energization and de-energization of danger alarm lamp.

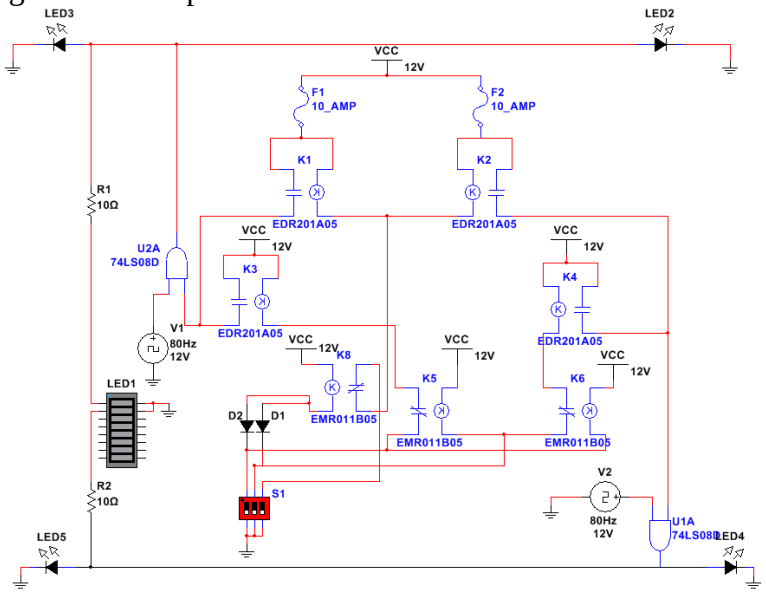

Fig.2. Overall circuit

6. Simulation Analysis of Intelligent Switching Circuit

In order to test the feasibility and power-on condition of the circuit, and to measure whether the frequency of the voltage conversion of the two-side steering lamp during the operating is in accordance with the actual situation, when simulating the circuit, the oscilloscope is installed in the circuit diagram, it is shown in Figure 3. One LED of the left steering lamp and one LED of the right steering lamp are connected to channel A and channel B of the oscilloscope, respectively. Starting simulation, observing whether the circuit has errors, and if there is no error, starting use the oscilloscope to generate waveforms.

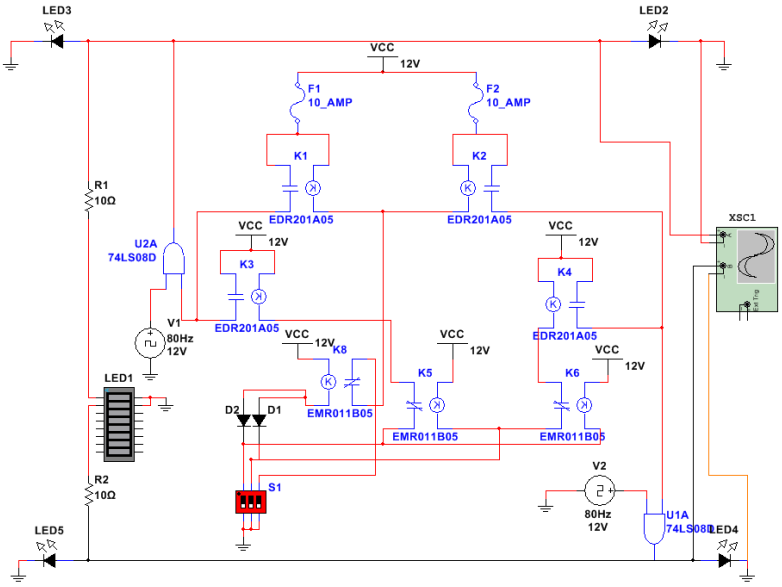

Fig. 3. Adding an oscilloscope in the overall circuit

6.1The Situation of Danger Alarm Lamp Circuit is Connected

When the danger alarm lamp circuit is connected, the waveforms of the four front and rear steering lamps displayed by the oscilloscope are shown in Figure 4. The Y-axis scales of channel A and channel B in the waveform diagram are both 5V/Div, and the scale of the X-axis is 10ms/Div. Both channel A and channel B are direct current. The waveform diagram is a waveform diagram generated by the oscilloscope when the danger alarm lamp is turned on. When the danger alarm lamp is turned on, the waveforms of the left and right steering lamps are coincident, the waveform diagram is displayed with white, and the blinking frequency is consistent, which proves that the voltage of left and right steering lamps supplied by the power are coincident and the circuit can operate normally.

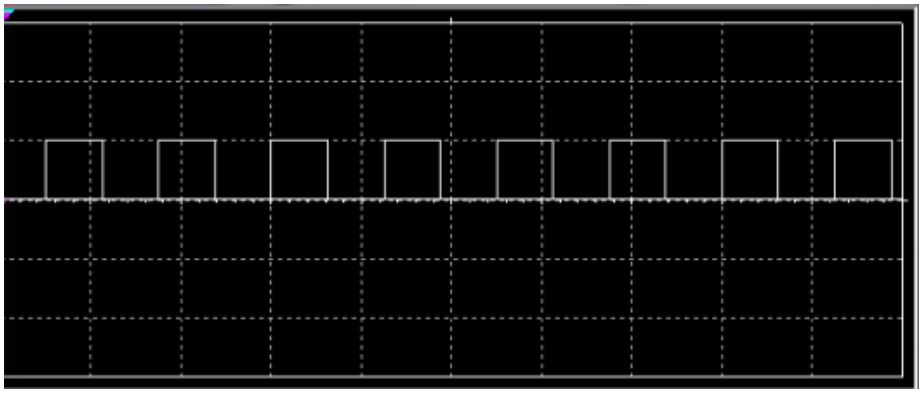

Fig.4. Waveform when danger alarm lamp is turned on

6.2 The Situation of Steering Lamps Circuit is Connected

It is shown in Figure 5, this waveform diagram is a waveform diagram generated when the left and right steering lamps are respectively turned on, because the one-side steering lamps is turned on, in the generated waveform diagram, the waveform is displayed with red, and the frequency is consistent with the frequency when the danger alarm lamp is turned on, so it can be concluded that when only the steering lamps circuit is connected, there is no fault in the circuit.

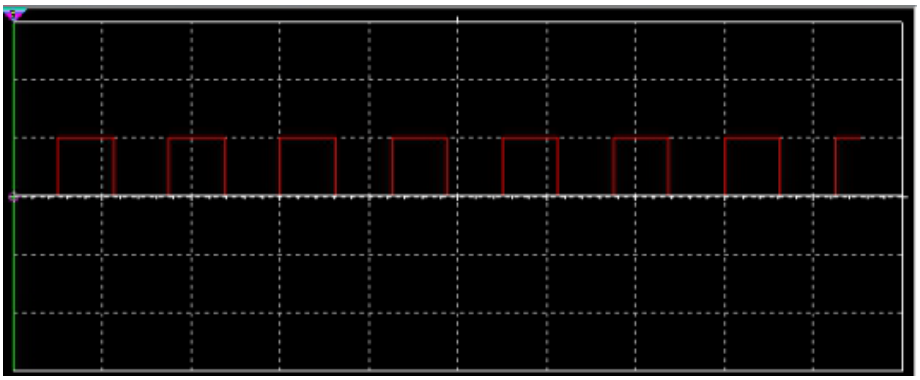

Fig.5. Waveform generated when the left and right steering lamps are turned on

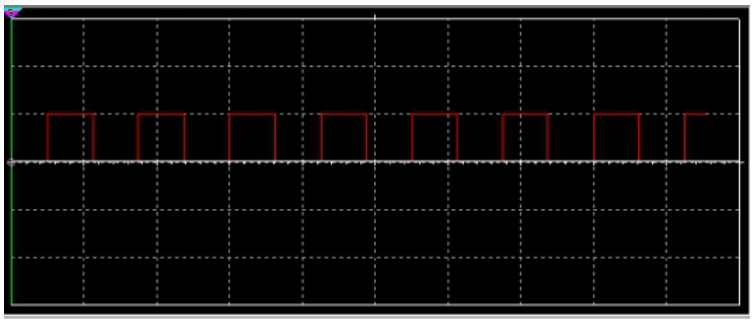

Fig.6. Waveform diagram when the danger alarm lamp and the left steering lamp are turned on simultaneously

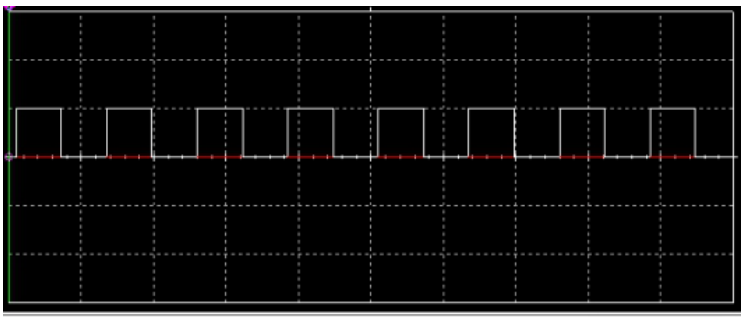

Fig.7. Waveform diagram when the danger alarm lamp and the right steering lamp are turned on simultaneously

6.3 The Situation of Both Danger Alarm Lamp Circuit and Steering Lamp Circuit Are Connected

When the danger alarm lamp is turned on, the circuit state is simulated when the left steering lamp switch or the right steering lamp switch is turned on, and the waveform generated by the oscilloscope in different circuit states is observed. The waveform generated when the danger alarm lamp switch and the left steering lamp switch are closed at the same time is shown in Figure 6. The waveform generated when the danger alarm lamp switch and the right steering lamp switch are closed at the same time is shown in Figure7. Comparing Figure 6 and Figure 7, when the danger alarm lamp switch is closed, the left and right steering lamp are respectively turned on, and the generated waveforms are consistent, so the circuit can operate normally.

7. Conclusion

According to the problem that the danger alarm lamp and the steering lamp in the automobile electrical system interfere with each other when they are turn on at the same time, an intelligent switching circuit solving the problem is designed under the consideration of safety, economy and reliability.

The circuit model is built, and simulation is carried out using Mulitisim software. Though simulation, it is verified that the designed intelligent switching circuit can realize that normally the steering information can be indicated when the danger alarm lamp and steering lampis are turned on at the same time.

This circuit has the characteristics of small component number, simple structure, high reliability, and practicability.

Acknowledgement

In this paper, the research was sponsored by the Youth Fund Project of Educational Department in Hebei Province in 2019 (Project Number:QN2019205).

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