Infrared Imaging Principle of the Front of the Vehicle

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Abstract. In recent years, with the progress of science and technology, infrared imaging is widely used in commercial and military, provide convenience for people's life, the car in front of the infrared imaging improved the car in the way of low visibility in the form of security. Through the analysis of infrared imaging principle, this principle is applied to automobiles, and a simple infrared imaging system is designed for automobiles. This system is applied to the car to reduce the danger of the car in all kinds of bad environment and weather, and improve the driving safety of the car owner

Keywords: Active infrared imaging of principle; safety; CCD.

1. Introduction

The frequent occurrence of road traffic accidents is closely related to the safety auxiliary equipment of vehicles. The more sophisticated the auxiliary safety equipment and the simpler the operation, the probability of safety accidents can be reduced. Especially in the harsh environment and unknown road conditions, the use of high-precision equipment can ensure safety. Automobile infrared front side imaging can provide clear and effective road conditions for drivers in various environments, and provide reliable guarantee for safe driving.

According to the world health organization, more than 1.25 million people die in traffic accidents every year, or 3,500 people die in traffic accidents every day. The figures also show that tens of millions of people are injured or disabled every year. Among them, traffic accidents are the leading cause of death for young people aged 15-29. Car safety has become a more and more concerned issue. Therefore, the study of automobile safety reflects the practical significance. The main reason for traffic accidents is that the driver's vision is not clear, and he does not understand the condition of the road ahead. Some cars use ultrasound-assisted systems that transmit and receive ultrasonic waves to get a picture of the car ahead, but the cost is too high to be widespread. As a result, low-cost, high-definition front infrared imaging of active vehicles is favored.

2. Vehicle Front Infrared Imaging Principle

The part with a wavelength of 2.0 to 1000 μm is called thermal infrared. Objects around us emit visible light only when their temperature reaches above 1000 ° C. By contrast, everything around us above absolute zero (-273 ° C) is constantly emitting thermal infrared. Therefore, the atmosphere and clouds absorb visible light and near-infrared rays, but are transparent to thermal infrared rays of 3~5 and 8~14. This gives one a clear view of what lies ahead on a completely dark night, or in cloudy environmental conditions.

Infrared imaging sensor CCD image acquisition, compared with radar and laser sensors, can provide the road direction and road obstacles size, distance and other information; The infrared imaging system is based on detecting heat, so it can be used throughout the day and in all climates. Therefore,
the driving safety of cars in haze, rainy day, snow day and other extreme weather is improved, which has practical research significance for human driving safety.

3. Systematic Design
The infrared imaging system in front of the car is composed of a microcomputer as the core controller, and peripheral circuits such as infrared Emission circuit, infrared receiving circuit, display circuit and alarm circuit.

3.1. Infrared Detection Module
The infrared beam is transmitted by the infrared irradiation lamp. The MCU only needs to send the switching signal through the C/T pin, and the infrared beam can be generated by the drive circuit transmitted to the input end of the emission module.

An infrared searchlight includes a lamp body, the lamp body is provided with a control circuit board, the control circuit board is provided with an LED infrared induction lamp, a battery and a main control module, the battery is used to supply power for the LED infrared induction lamp and the main control module, the LED infrared induction lamp is electrically connected with the main control module, the control circuit board is also provided with a solar silicon chip and the solar silicon chip To generate electric energy, on the one hand, the generated electric energy is connected with the battery to supply power for the battery; on the other hand, the feedback current signal is sent to the main control module by the signal acquisition and feedback module. The main control module adjusts the output current through control to ensure the stability of the output current. The lamp body is also provided with a shoulder strap hanging rope.

![Figure1. System frame diagram1.](image)

Furthermore, the control circuit board is also provided with an overload automatic protection unit.

Further, the signal acquisition and feedback module comprises a current transformer and a voltage transformer.

Further, the lamp body base is a magnet base.

Compared with the prior technology, The infrared searchlight used has the following advantages:
(1) this new searchlight has low cost, simple structure, convenient operation, and small space, which can realize stable current output and automatic overload protection. It has high frequency stability, strong anti-interference ability, and improved intelligence;
(2) the utility device is convenient to carry, which is realized by using a shoulder strap rope, and conveniently placed by using a magnet base.

The infrared receiver includes an infrared imaging sensor, a signal amplification module and a conversion circuit.
Receive the light reflected by the irradiated obstacle, focus on the CCD chip through the lens, and then the CCD chip gathers the corresponding proportion of electric charge according to the intensity of the light. Periodic discharge generates an electrical signal of a picture, which is filtered and amplified by the receiving circuit to form an analog graphic signal output.

**Specific steps:**
1. The light reflected from the scene is transmitted to the CCD through the lens of the camera.
2. When the CCD is exposed, the photodiode is excited by the light and releases a charge, thus generating the electrical signal of the sensor.
3. The CCD control chip uses the control signal line to control the current generated by the photodiode, which is output by the current transmission circuit. The CCD will collect the electrical signals generated by the primary imaging and uniformly output them to the amplifier.
4. After amplification and filtering, the electrical signal is sent to A/D, by which the electrical signal (at this time, it is an analog signal) is converted into a digital signal. The value is directly proportional to the strength of the electrical signal, that is, the voltage. These numbers are just the data for the graph.

### 3.2. Video Display Module

First, the input image of the image signal is transmitted to the SAA7115 decoder, which converts the signal into a parallel BT.656 image code-stream and sends it to the DSP video port VP0, which is then decoded by DSP to obtain the image in YUV format and transmitted to the dynamic memory (SDRAM) for storage through EDMA. By accessing the image data in the SDRAM, the CPU performs corresponding image processing or output in accordance with the corresponding program to observe the road ahead on the display screen in real time.

A complete CCD device consists of photosensitive unit, transfer gate, shift register and some auxiliary input and output circuits. When the CCD is working, the photosensitive unit samples the optical signal within the set integral time, and converts the intensity of the light into the charge of each photosensitive unit. After the sampling, the charge of each photosensitive element is transferred from the transfer gate to the corresponding unit of the shift register. The shift register transfers the signal charge to the output successively under the action of the drive clock. By connecting the output signal to a picture display or other signal storage and processing equipment, the signal can be reproduced or stored and processed. Because CCD photosensitive element can be made very small (about 10um), its image resolution is very high.

![System frame diagram](image)

**Figure 2.** System frame diagram.

### 4. Conclusion

This paper introduces the principle of active infrared imaging. Each module of the system (information receiving, control, information feedback, imaging) is analyzed and introduced in detail. This system is compared with other automobile infrared systems, and the conclusion is that the safety is more stable, the cost is local and the system is easy to operate.

The infrared imaging sensor -- CCD chip is used as the receiver, the DSP system is used as the video processing software.
The active infrared imaging system is mainly used for extremely severe weather, so that the car can drive safely in various environments. For image processing, the black-and-white CCD camera and DSP system are used to simplify the image, so as to reduce traffic accidents.

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