Analysis and Design of IR Driven Circuit for Infrared Touch Screen

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Abstract. Infrared (IR) touch screen is a reliable and stable product of human computer interaction, and there are two kinds of infrared drive mode, which are constant voltage driven and constant current driven. In production engineering, constant voltage driven mode is often used considering of the cost. Two kinds of driven circuit were designed in this paper, and the power supply ripples are analyzed to put forward more suitable IR driven mode for infrared touch screen.

Introduction

With the development of internet technology and information technology, human-computer interaction is also in constant development and improvement, from the earliest tape input, keyboard and mouse input to the touch screen interactions now; which all show the convenience of the change of information technology to human. Using the touch screen, people can get rid of the mouse and keyboard through the touch of a finger. It can be the same function as a mouse or keyboard, by which people can interact with information whenever and wherever possible, and changes of turning the world upside down to people's life have happened.

Infrared touch screen has great advantages in definition, stability, precise positioning and so on. Therefore, the infrared touch screen has a wide range of applications in industrial control, home appliances, commercial, aerospace, education and other industries. Especially with the development of China's smart city strategy, touch screen technology is bound to play an important role in the construction of smart city [1]. Moreover, for the smart home as a representative, the use of touch screen to achieve intelligent home equipment monitoring and control, will make the touch screen to penetrate into people's homes, and will be gradually used in various fields more widely.

In the design of the infrared touch screen, there are two kinds of IR driven modes, which are voltage driven and current driven. The driving circuits and the ripples on the two driven modes were compared in this paper to put forward a more stable IR driven circuit of infrared touch screen.

Infrared Touch Screen

The touch screen is a display device mounted on the front end, used to control the display device, and the device can be operated without using mechanical buttons but directly with the screen icon finger or pen contact equipment. Users get the new experience of the operation experience through the fingers of light pull, point and other human nature of the most natural action to interact with the product device [2]. Currently the main touch screen can be divided into four categories: resistance touch screen, capacitive touch screen, surface acoustic wave touch screen, infrared touch screen [3, 4]. The front two are thin film type because a film should be added before the display screen in use. The touch part of the surface acoustic wave touch screen is a flat surface, a sphere or a cylinder. Due to the presence of the film and the glass plate, the light transmittance of the display is greatly affected. At the same time they have insurmountable barriers, such as the problems of single sensor damage, aging, drift of device parameter, difficulty of long time stable work, fear of touch interface pollution and complex maintenance.
The infrared touch screen is a kind of touch screen with infrared light scanning mode, whose main part consists of scanning optical IR (940nm infrared emitting diode) and PT (sensitive infrared receiving triode with the center frequency of the 940nm). The hardware system controls the on and off conditions of IR and the corresponding PT, which collects the signals when PT working to do calculation, and the calculated results are converted into absolute coordinates of 32767 × 32767 value, which are transmitted to the host computer via USB or UART interface.

The infrared touch screen uses an enhanced infrared scanning technology, as shown in Figure 1. It takes the scanning mode of one emission light corresponding to 5 receiving lights, which enhances optical density and improves the touch precision of the touch screen.

**Constant Voltage Driven Mode**

The performance parameters of IR are mainly considered such as transmit power, half power angle, power and temperature, and so on. The lights used in this project are the version of IR26-51C-L302.

Infrared touch screen has two kinds of IR driving mode, which are voltage driven and current driven. Corresponding constant voltage driving circuit and constant current driving circuit are designed in this paper to test and compare the power supply ripple of the two driving modes.

In actual engineering, taking consider of the cost, voltage driven mode is usually applied and the schematic diagram of constant voltage driven circuit is shown in Figure 2.

SN54HC164/SN74HC164 are 8 bit shift registers. When one (or two) is gated, the low level of serial input port are prohibited from entering new data, the first trigger is reset to low after the next clock pulse coming, and the gated serial input ports (A and B) can completely control the input data. After a high level input, the other input is enabled which determines the state of the first trigger. Although the clock is at a high or low level, the data in serial input port can be changed, but only the information which meets the establishment requirements can be input. Clock control occurs when the clock input is changed from a low level to a high level. In order to reduce the transmission line effect, all the input ends are clamped by the diode [5].

In voltage driving mode, the +5V power supplies through the two resistors, 74HC164 gates a triode through series in/parallel out each moment, and 74HC238 gates one channel of ULN2003 through the chip select signal each time. The +5V power lights LED through the resistor, triode and Darlington driven tube. The turn-on voltage of triode is 0.3V, while that of LED is 1.0V, and Darlington driven turn-on voltage is 0.3×3=0.9V (the drawback of Darlington switch triode is that its output voltage drop is one series more than the general switch, which is the additive value of two output voltage drop. Since the power of first transistor is low, the output pressure drop is generally very large; the output voltage drop of Darlington switch transistor is about three times of that of general switch transistor). The sum of all voltages is about 0.3+1+0.9=2.2V. The +5V voltage will be pulled low after LED is turned on. Although there is a filter capacitor, it will also cause a relatively large ripple.
The tested positive electrode of filter capacitor in the 5V power input port is shown in Figure 3 and Figure 4.

It can be found through the test results shown in Figure 4 that the power ripple of constant voltage driven mode is larger.
**Constant Current Driven Mode**

The schematic diagram of constant current driven circuit is shown in Figure 5. MBI502616-a chip of 16 channels of constant current source driver is used in the circuit. MBI5026 is a 16 bit constant current LED driver, which has a relatively wide range of applications. Its current output value is stable and the error between each other is small. It can also use an external resistor to regulate the output current (5-90mA), its operating voltage is 5V and the chip can be cascaded by SPI bus [6].

![Figure 5. Principle of constant current driven circuit](image)

For the circuit shown in Figure 5, tests were made at the positive of filter capacitor in 5V input as shown in Figure 6 and Figure 7.

![Figure 6. Test point.](image)

![Figure 7. Ripple test result.](image)

It can be found through the test results in Figure 7 that compared to Figure 4, the power ripple of constant current driven mode is smaller.

Through the tests above, conclusion can be made that from the aspect of power ripple, the constant current driven circuit is better than the constant voltage driven circuit.
Summary

The power ripple tests of two kinds of circuits (the constant voltage driven circuit and the constant current driven circuit) were carried out in this paper. The test results show that the driving power of the voltage driven mode is bigger, and its ripple is bigger.

Since infrared diode is a current driven device, when the power supply voltage exceeds 1.5V, its luminous power is proportional to the current. Using constant current source driven circuit to drive the infrared diode can obtain relatively stable power output and its ripple is smaller.

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