

# Persistence of Vision

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**Abstract**—The shaking display device is based on the persistence of human visual persistence. It is a display device that refreshes 16 light-emitting diodes to display information such as output text or pattern by using time-sharing system. The frequency control of the output signal is realized by a single chip microcomputer, and the current shaking state is detected by a shaking sensor. When shaking, due to the human visual persistence principle, a visual plane will be generated in the shaking area of the light emitting diode, and the diodes in the visual plane will generate images in the shaking area through refreshing at different frequencies, thus achieving the function of conveying information on the visual plane.

Visual persistence is widely used in life, such as film production and television broadcasting about 25 pictures per second. It is a phenomenon of visual persistence that makes people's brain feel objects moving in time.

**Keywords**—POV, SCM, sensor, LED, MCU

## I. INTRODUCTION

Persistence of vision is a phenomenon that the vision generated by light on the retina remains for some time after light stops acting. It is wildly used as shaking stick, finger peg-top, Cross rotating machine etc.

## II. EASE OF USE

First, let's analyze what is POV. In fact, people's eyes are very easy to deceive, as long as you let the motor scan faster. The flash will not be visible to the naked eye at more than 24 frames per second, so make sure the motor speed is above 24 revolutions per second. In this way we will feel the rotation of the word is very stable and clear in the air.

The Cross rotating led system seems like a circle when it is rotating. So we need to have a sensor to tell where the starting point is, some people use hall sensors, others use infrared tubes. We use a hall sensor, to make it easy to implement. Starting point detection is very important, microcontroller is based on this starting point to determine whether to start to display data. If the starting point cannot be detected, the SCM will not start to display.

### A. Test display

Use the principle of text mode to make a column of lights continuously send data to achieve a text display. We used PC2002 subtitle software. Take a Chinese character of 16 by 16. Start from the first column and take 8 points for each byte. If there are less than 8 points at the end, the 8 bits will be filled. The order of module selection is from low to high, that is, the first point as the lowest position.

a) Text mode principle: 16\*16 mod is one column by one column, two bytes, 16 columns Therefore, one Chinese character of 16\*16 has 32 bytes, which needs to occupy the Code space of a single chip. Combine the hardware to analyze, as shown in the figure below.

16 lights in a column correspond to 16\*16 Chinese characters in a column: 2 bytes, so the data from the module is sent to port P2 and P4 P5 in turn. \* P4 P5 in the hardware is a byte.

b) Principle of display: When the chip IO determines that the infrared receiving tube receives the starting signal, it will start to display. After displaying 16 columns, wait for the next starting signal. So as long as the motor speed is fast enough will be stable to display the word in the air plane of the text show the same

c) Subtitle counter: With each turn of the rotating LED, the subtitle counter is incremented, pointing to the next column, so that the constant refresh feels like the text is moving

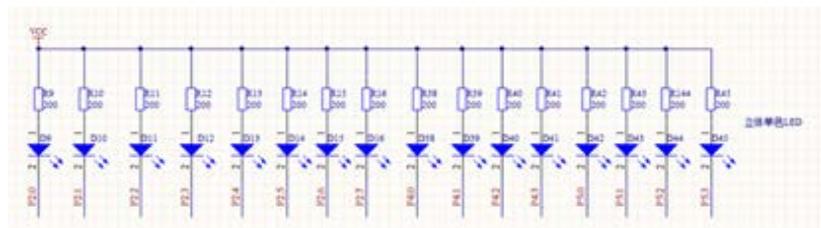


Figure 1 Connection diagram

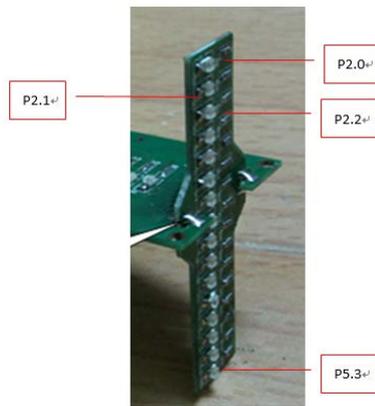


Figure 2 Circuit board

### B. Power supply

Wireless power supply is adopted, and the circuit principle is to convert dc into ac, then through the primary coil, and finally through the secondary coil induction electricity, after the rectification filter power to the rotating part. The dc ac circuit is a self-excited oscillation circuit.

## III. HARDWARE SYSTEM DESIGN

### A. System composition

The main circuit is a mercury switch and 16 LEDs as sensors welded into the MCU's minimum system. At the same time, the power supply circuit is the power supply which converts the battery voltage into 5V DC. Use ISP to download charts so that the program in MCU can be modified. The LED used for display occupies two ports P0 and P2 (16 ports in total), so that 16 Chinese characters can be fully displayed. In the process of displaying Chinese characters, position sensor is indispensable. \*The mercury switch is used to detect the running state of the rotating body, occupying the external interrupt 0, or P3\_2 port.

### B. B. Integral structure

a) The whole product is composed of three parts, namely the main control part, display part and power part. Place each of them on three identical boards, and fasten them together with structural parts. The display part and sensor are arranged on the display board. The main control part is the minimum system of a single chip microcomputer, arranged on the main control board. The power supply part is composed of battery and voltage stabilizing circuit, arranged on the power board.

### b) Circuit simulation

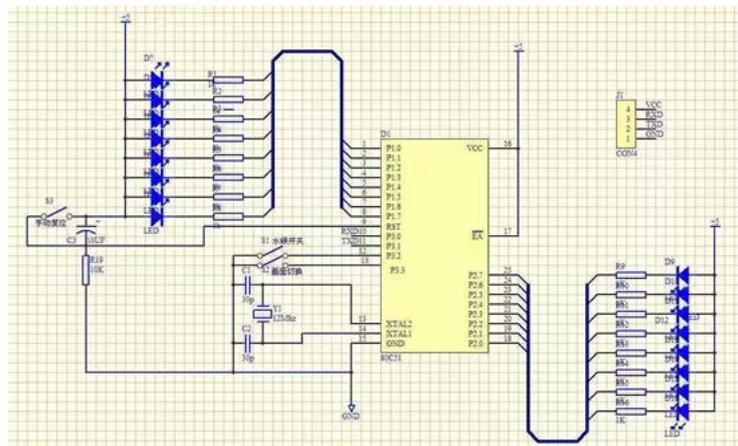


Figure 3 Circuit simulation

### c) Component list

- 0.8mm ultra clear small volume rotary board three in one circuit board
- 3-6v long shaft motor: It is specially designed that can drive the circuit board to rotate in a circle to make the LED light emitting diode on the board move in a circle. In order to reduce the speed of the motor, the voltage drop of diode is used to power the motor.
- 32 super bright led on blue 0805 patch
- A chip package of 44 pin STC89C(LE)51 master control chip

- Wheel connector: This is a special adhesive for the motor shaft and main board, otherwise the line will not allow the motor to rotate.
- Chip resistor, Infrared, Infrared acceptor, Contact pin, Diode, Resistance, Capacitance etc.

#### IV. SOFTWARE SYSTEM PROGRAMMING

Flow diagram

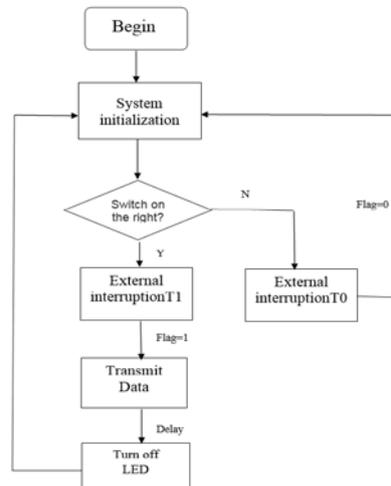


Figure 4 Flow chart

#### V. SYSTEM TESTING

Debugging process

Test the LED display circuit and the C51 MCU minimum system. First test the LED and input a simple program (`#include<reg51.h>main(){p1=0*00;p2=0*00;}`) It is found that an LED is not bright, so the LED's pin is checked. It is found that the circuit is broken and the LED lights up after being connected. The LED does not flash. It is suspected that the digital tube chip has poor contact with the socket. The socket is soldered again. The explanation is not the problem of the slot, so repeated inspection of the minimum system module, by using the voltmeter most digital tube of each pin for high and low level testing, the most always found is the wiring problem. The hardware and software Settings mismatched, resulting in LED display abnormal correction after the manual shaking can be retested to render images.

The second step is to test the driving circuit.

Third, Complete. In terms of software testing, part of the software is changed to mainly adjust the delay function.

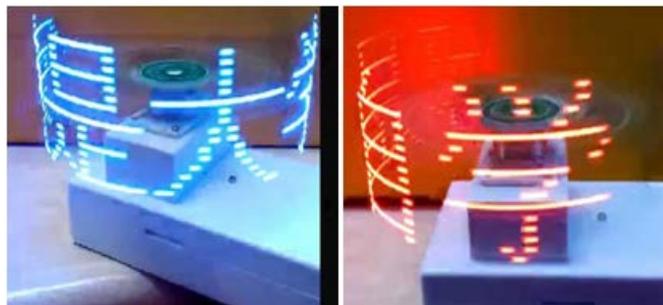


Figure 5 Text result

#### VI. CONCLUSION

Under the guidance of Professor Liu, the design of cross rotation and fingertip gyroscope was completed over a period of time. This design takes the practical application of POV as the background and USES the single chip to instantiate the shaking display. An LED shaking display is designed to display the text image and other information. In the aspect of design, the principle of variable self-addition is adopted, and the content to be displayed is displayed through the method of reading one by one. Finally, the following points are drawn:

At the beginning of the new course design, I had no idea and was struggling. I felt that I had not gained a solid knowledge of theoretical knowledge, so I went back to the textbook and sorted out the knowledge systematically and comprehensively. Finally, I mastered the basic theoretical knowledge and grasped a lot of difficult knowledge that is hard to understand in normal times.

The design has a market prospect, which can meet the publicity needs of various large-scale performances, rallies and parades, and provide convenience for people's life.

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