
A Novel Design of Dot Matrix LED Large Screen

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Abstract

In this paper, the design method of LED graphic display system is discussed. The design includes display circuit, display driver circuit and dynamic display circuit. The design of the host computer software system is also discussed.

Keywords

LED; Serial Communication; MCU; CPLD

1. Introduction

LED is an important display of public information, in which, the large screen dot matrix LED is applied in many occasions. In this paper, a large, small screen are suitable for display control circuit by high-speed CPLD, dual port RAM and other technologies. In particular, combined with single chip microcomputer, CPLD and dual port RAM, the complex tasks is assigned to different hardware processing to meet the requirements of real-time.

2. The Principle and Characteristics of Dot Matrix Led

Graphic and text information first is processed to corresponding digital video signal, which is transmitted to the LED display cache by digital communication system. Then, a display unit control circuit reads the corresponding display information to display[1]. The characteristics of dot matrix LED are as follows:

- (1) In the overall design, more advanced distributed control (DCS) theory is used;
- (2) In the local design, modular design is adopted;
- (3) Advanced distributed scanning technology;
- (4) High performance communication interface;
- (5) Novel software design;
- (6) Good visibility;
- (7) Simple installation

3. Hardware System Design

(1) Display driver circuit design

The main part of the LED is the display dot matrix, row and column driving circuit. Modular design is used for screen body, the unit module of 128 x 32 size is designed, and the entire display screen is composed of these small modules combined with the expansion. In the control circuit, the dynamic array scanning drive mode is adopted to drive LED device, one controller per two lines controls to complete row and column drive of the entire display circuit^[2]. The display driver circuit composed of 74HC595 (with 1/16 scan as an example) is shown in figure 1.

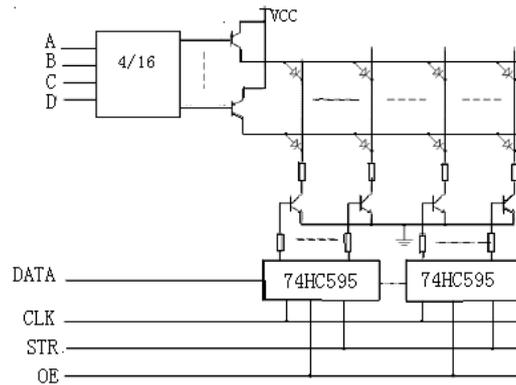


Figure1 LED driver circuit

74HC595 has the shift function of series in/ parallel output and parallel latch, which can effectively solve the problem of data serial transmission and data display in time.

(2) Scan circuit design

The function of the scanning unit is mainly to copy the lattice information data of the display memory to the whole screen. In order to make the control unit and the scanning unit work in parallel, a dual port random access memory(RAM) CY7C132 is used as the display memory. In dual port RAM, one port is used as read output of the scanning unit, and the other port is used as update the input of control unit to the display information. The entire display screen is transverse cut into 12 scanning units, each scanning unit corresponding to the 3Kb display memory and are independent of the work.

Scanning unit outputs address signals (addr) from reading memory and read (RD) signal, but also outputs row address signal (add2-0) required by controlling display unit, data signal (data) point clock signal(CLK_1)and rows of data latch signal. The structure principle diagram as shown in figure 2

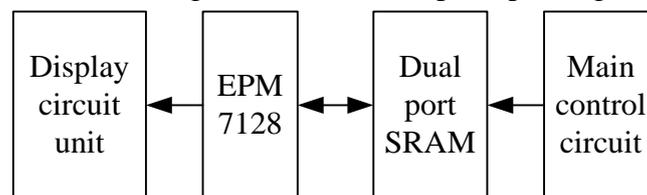


Figure 2 Scanning unit structure

(3) Communication circuit design

In this system, AT89C58 from ATEML company's microcontroller is used as slave computer, which serves as data processing, storage and communication. The PC sends dot matrix data representing the word or graphic to the microcontroller by the serial port, the microcontroller stores them in EEROM 28c64,then according to the display requirements, microcontroller process these data and storage them at some specific address for scanning display by the scanning module^[3].

Because of using the dual port RAM ,MCU stores the data collected to the dual port RAM, the DSP device take out the data from the dual port RAM to real-time operation, the data is stored in the dual port RAM after processing. MCU takes out the data from the dual port RAM to control the object or to communicate with the host computer.

In the communication interface design, the MAX485 interface chip from Maxim is adopted, which uses a single power supply +5V, rated current 300 uA and using half duplex communication mode. It can achieve TTL level conversion for RS-485 level. The level conversion diagram is shown in figure3.

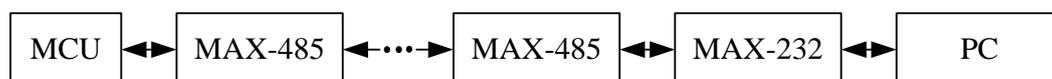


Figure 3 The level conversion diagram

4. Software System Design

System software consists of two parts: the host computer software by VB6.0 and the slave computer by assembly language. Display control software is achieved by the MCU language, which consists of the main program and interrupt service program. The main program completes the necessary initialization work, and is responsible for display, read out data according to the requirements of the display, generate the control signal. Serial port interrupt service program solves the problem of communication with the host computer.

MCU software process as shown in figure 4. MCU first confirm that it is cold or hot start after power on, if it is cold start, a variety of signs and memory will be cleared in the initialization process, and set a variety of programmable control registers. If it is the hot start, it means that the main CPU is in interference and non normal working state, which is reset by the watchdog circuit and restart, in this case, the memory cannot be cleared, and should as far as possible to restore the previous state.

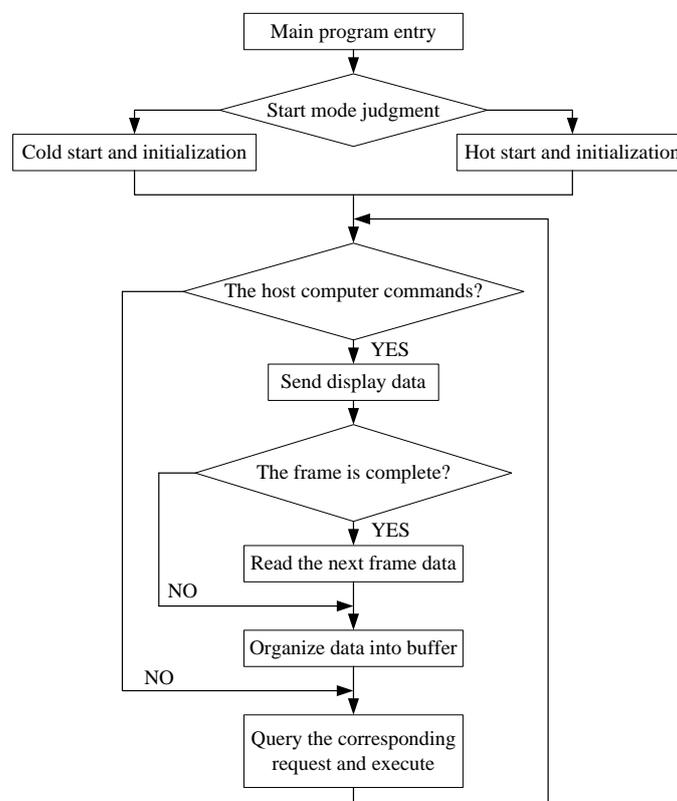


Figure 4 MCU software flow chart

MCU procedures after the system normal operation first query whether there is a storage display. If there is, the display data will be pulled to the dual port RAM memory for display. Because the amount of the display data is relative large, they should be displayed on page, so it is first determined whether the previous page of data is sent, if not, the data should continue to be put into buffer, if finished, the next page of data should be read., In this cycle, the data sent by the PC is read into the display data buffer. The communication program between PC and MCU is written in VB language, the communication protocol, data transmission format, transmission rate and working methods need be made in communication. The asynchronous receiver transmitter UART is used in PC serial communication. Its sending and receiving registers are 8 bits, so the sending and receiving operations are only in bytes. In this system, the communication format is: baud rate 2400bps, eight bits of data, a stop bit, no parity, with ten bits of data consisting of a frame, it is determined whether the received data is correct by accumulation and verification.

5. Conclusion

In this paper, according to the actual application requirements, a LED display control system is completely designed. The drive, display, scan, control and communication circuit of the system are analyzed and designed in detail, which is basically in line with the expectation, and it is applied in practice. In this paper, the embedded structure is proposed, the system realized LED display module, by a dual port static RAM and double CPU sharing data, the realization of the rapid exchange of large amounts of data is one of the main features of this paper

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