World Scientific Research Journal Volume 6 Issue 12, 2020
ISSN: 2472-3703 DOI: 10.6911/WSRJ.202012_6(12).0009

Development of Graphical Aircraft Landing State Monitoring System

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Abstract

In view of the backward hardware structure and single function of the traditional aircraft landing state monitoring system, this paper puts forward a solution of the aircraft landing state intelligent monitoring system based on MSP430F149 single chip microcomputer and touch screen. The hardware design software programming of the whole system is analyzed and designed in detail. The experimental results show that the system realizes the graphical monitoring equipment and works stably and reliably.

Keywords

Monitoring system; MCU; touch screen; MSP430.

1. INTRODUCTION

Aircraft landing monitoring system is an important means to monitor landing gear, flap, tail pry position. It is mainly used to indicate the position of landing gear, flap and tail pry. It is the main basis for pilots to understand whether the aircraft is in normal flight condition and whether it can land. It is an important monitoring equipment related to aircraft flight and landing safety. The traditional aircraft landing state monitoring system can only play an indicative role, and the related control is independent of each other, the hardware structure is backward, and the volume is large, the function is single, can not meet the needs of aircraft development.

As a new type of display input device, touch screen has the advantages of simple and convenient, fast reaction speed, space saving, easy operation, simple interface, flexible programming and so on. It is widely used in various fields. Therefore, this paper puts forward an intelligent monitoring system solution of aircraft landing state based on MSP430F149 single chip microcomputer and touch screen. Through the form of image, the position state of the monitoring position is described, and the intelligent monitoring function of the aircraft is effectively completed.

1.1. Overall Monitoring System Programme

The graphical aircraft landing state monitoring system is mainly composed of single chip microcomputer module, communication module, drive module, relay module and embedded touch screen module. The system structure block diagram is shown in figure 1. The user can test the status of the aircraft landing gear, flap and tail pry through the embedded touch screen. The related instructions are sent to the single chip microcomputer module through serial communication, and then the related equipment is driven, and the landing state of the aircraft is directly reflected on the embedded touch screen.

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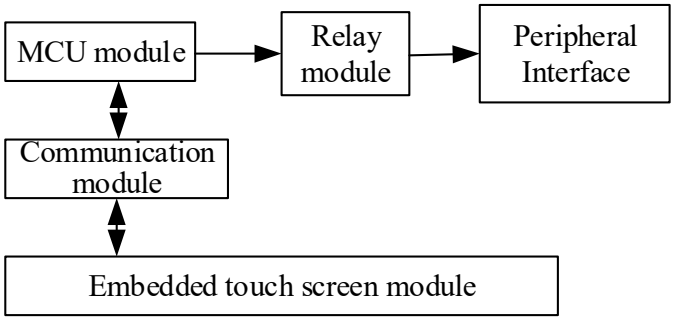

Fig 1. System structure diagram

2. DEVELOPMENT OF HARDWARE CIRCUIT OF MONITORING SYSTEM

2.1. Embedded Touch Screen Module

Embedded touch screen module is the core of graphical aircraft landing monitoring system. This paper uses a 32-bit ARM processor +FPGA dual-core control architecture to develop a high-performance, low-power, easy-to-use 64-color TFT real-color display, can be directly connected to MCU with UART serial interface. In addition, Embedded touch screen with 1 GBit Flash storage capacity, Built - in font, Advantages of supportingdrawing and picture display [2]. The embedded touch screen uses DC 5 V power supply and 255 level controllable backlight control to meet the requirements of aircraft landing status monitoring system.

2.2. MCU Module

The MCU module uses MSP430F149 single chip microcomputer as the control core, MSP430F149 is an ultra-low power consumption 16-bit hybrid signal processor introduced by TI company, which integrates a variety of leading technologies. It has 16-bit RISC processor, ultra-low power consumption, high performance analog technology and rich internal and external devices, as well as asynchronous communication mode and synchronous communication mode [1] The operating speed is much faster than that of ordinary 51 monolithic. The MSP430F149 crystal oscillator is 16 MHz, and the circuit diagram of the minimum system is shown in Fig .2.

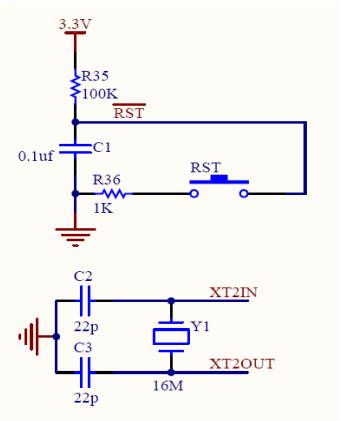

Fig 2. Minimum system circuit

2.3. Communication Module

The communication mode between touch screen and single chip microcomputer can be divided into two categories: parallel communication and serial communication. Parallel communication is usually the transmission of data bytes by multiple data lines at the same time. The parallel communication control is simple and the transmission speed is fast, but the transmission line is more and the cost is higher. Serial communication is the transmission of

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data bytes one by one on a transmission line. There are few serial transmission lines and low cost in longdistancetransmission [3] Considering the advantages of simple serial communication structure, reliable communication and diverse baud rate selection, this paper chooses RS232 serial communication mode. In this system, the single chip microcomputer can receive information, reflect the information on the touch screen through the form of instruction, at the same time, it can also receive instructions from the touch screen, and drive the relay as the executive device to complete the related operation. The circuit diagram is shown in figure 3.

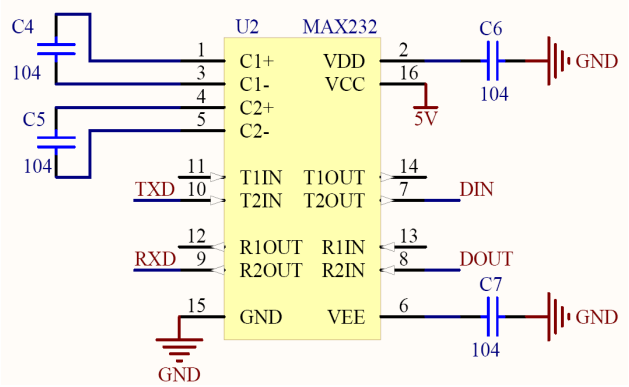

Fig 3. Communication module circuit

2.4. Relay Module

The relay module is used to control the display status of the aircraft landing status indicator. Because of the high power of the indicator lamp, it is necessary to design the relay drive module to improve the load capacity of the single chip microcomputer. The relay drive module drives the high voltage relay through the inverse phase ability of the 74 LS04 chip, and then realizes the control function by ULN2003 the voltage and current amplification function of the chip. ULN2003 is a large current drive array, mostly used in single chip microcomputer, intelligent instrument, PLC, digital output card and other control circuits. Can directly drive relay and other loads. ULN2003 input 5 VTTL level, output up to 500 mA/50V.The relay drive module circuit is shown in figure 4.

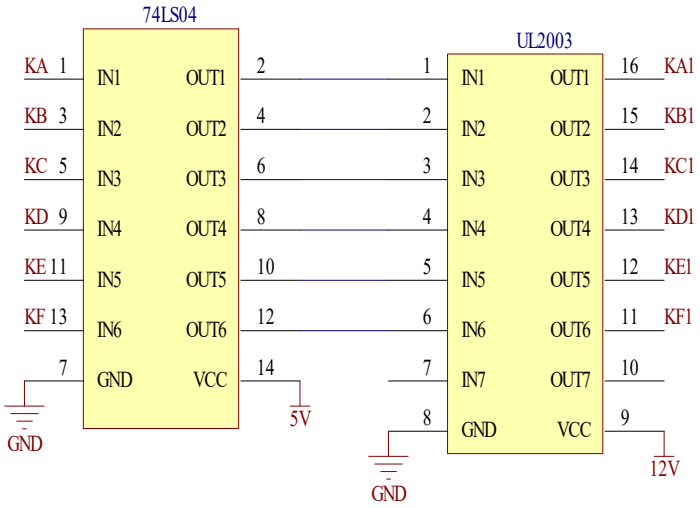

Fig 4. Relay module circuit

3. SOFTWARE PROGRAMMING FOR MONITORING SYSTEMS

The aircraft landing state system software is written in C language in IAR Embedded Workbench environment. The program flow chart is shown in figure 5.

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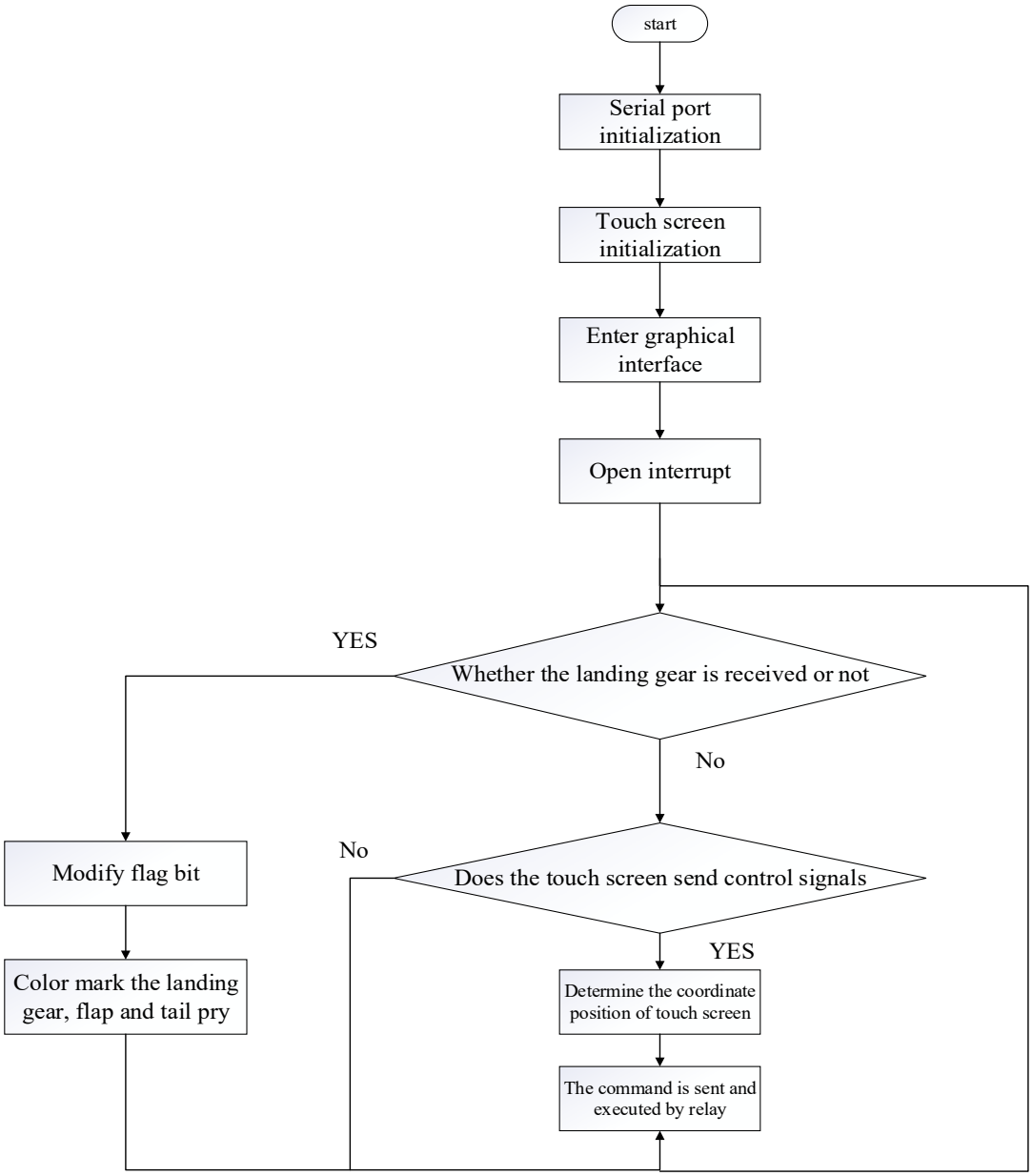

Fig 5. Program flow chart

Test system software is mainly automatic test, or manual test; automatic test interface, do not need user participation to complete the signal box indicator lights on, and through the text description of the test process; manual test, The appearance of the landing signal lamp box is depicted graphically, and the indicator lights are manually connected and disconnected through the position of the indicator lights in the product.

In the specific programming MSP430F149 the serial port initialization part mainly defines the instruction format of the data touch screen as shown in Table 1.

Table 1. Format of instruction frames

Instruction	EE	XX	XX	FF FC FF FF
Note	Frame header	Instruction	Instruction parameters	End of frame

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The initialization part of touch screen includes handshake command (instruction 0 x00), clear screen command (instruction 0 x01), buzzer control command (instruction 0 x61), touch screen control command (instruction 0 x70) and set baud rate command (instruction 0 xA0), etc. Through these commands, the MCU module and touch screen module are organically linked together to work together [4-6] The object to be monitored is identified by drawing graphics and displaying text.

Where the envelope in the figure represents the shape of the aircraft, the inner box and the lower box of the envelope represent the position state of the three landing gear, and the three boxes on the right represent the position state of the landing gear, flap, tail pry. When the corresponding position is marked green or red, the monitoring target reaches the corresponding position state, otherwise it is not in the position state. At the same time, according to the actual needs can expand the "self-inspection "," day and night" layer switching and other functions.

As the whole interface is designed to judge the coordinate domain, the coordinate domain is mainly the region, and the upper left corner (X) is determined by the actual measurement2Y, I2(X) and lower right1Y, I1) [3]When a finger presses the touch screen, the contact coordinate value (X,Y) is passed to the single chip microcomputer, according to whether the X of the comparison coordinate value is satisfied2<X<X1and Y2<Y<Y1to determine whether the contact is in the functional coordinate domain. There are 11 functional coordinate domains in this interface, corresponding to 11 different controls.

4. EXPERIMENT

After connecting the test equipment with the product, it can receive the information and adjust the display screen according to the information. At the same time, it can also send instructions through the touch screen, control the relay in the circuit to complete the related operation and other functions.

5. CONCLUSIONS

A large number of switches in the traditional monitoring system are reduced and eliminated by MSP430F149 the image aircraft landing state monitoring system with single chip microcomputer and touch screen as the core. The equipment works stably and reliably, and the modular design is convenient for disassembly and maintenance.

REFERENCES

[1] Shen Jianhua, Yang Yanqin. Principle and Practice of MSP430 Series 16-bit Ultra-low Power Single Chip Microcomputer (Beijing University of Aeronautics and Astronautics Press ,Chinese (2018) p13-15.

[2] Cao Xue, Yang Lizhi. Research on Communication Method of Kunlun Touch Screen and STM32, Application of Single Chip Microcomputer and Embedded System,Vol. 5 (2020),p.51-52.

[3] Qiao Yuanjian. The application of touch screen technology based on RS-232 in experimental press ,Inverter World, Vol. 4 (2020),p.68-70.

[4] Xu Jingsheng, Zhou Luqi, Xu Yifan. Application of touch screen man-machine interactive system in intelligent electric meter,Electrical Technology, Vol. 4 (2020),p.85-86.

[5] Li Anjun, blue float first. Application of Touch Screen System of 51 Single Chip Microcomputer ; Computer Science and Technology , Vol. 4 (2008),p.42-46.

[6] Zhang Shoubo. Principle of Touch Screen and Its Application in Embedded System: A,Technology Heilongjiang Water Conservancy Science and Technology ,Vol. 33No.1 (2005),p.5-6.