Design of Agricultural Machinery Positioning and Monitoring System Based on Beidou/GPS

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Abstract: This paper designs an agricultural machinery positioning monitoring system, which can collect the positioning information of agricultural machinery operation, and is of great significance for precision agriculture. The system uses stm32f103rct6 as the controller, with Beidou + GPS dual positioning module and display screen and other related accessories, to achieve the accuracy and real-time positioning of agricultural machinery.

1. Introduction
Precision agriculture is the core of future agricultural development. As one of the components of precision agriculture technology, satellite positioning and navigation is the basic technology that can realize soil and crop monitoring, agricultural machinery positioning and intelligent operation. [1] With the rapid development of satellite navigation technology in recent years, it has been able to provide high-precision positioning services for agricultural work. In addition, this technology has a great application space and is the core component of precision agriculture technology development in China in the future. [2]

The application of satellite technology in precision agriculture is mainly reflected in two aspects: (1) the positioning of agricultural machinery is conducive to the acquisition of field information; (2) the automatic navigation function, which can reduce the waste of agriculture and resources, and improve the utilization rate of energy and the quality of agricultural machinery operation. [3-4]

2. System scheme design
The positioning and monitoring system of agricultural machinery mainly realizes the function of monitoring the positioning information of agricultural machinery, and displays the longitude, latitude, height, time and other information of agricultural machinery on the display screen in real time.

First, according to the system requirements, determine the controller, satellite module, display screen and other component models, and then according to the selection, complete the circuit design and control program design and debugging. The system design flow is shown in Figure 1.
3. Hardware design
The system hardware design adopts the integrated modular scheme, which is mainly divided into core module and auxiliary module. Stm32f103rct6 chip control module, atk-s1218f8-bd GPS / BeiDou module (including antenna) are the core modules of the system, which constitute the main body of the system. Their performance is an important index of the system effectiveness and reliability. Auxiliary modules include display module and power module, which serve for functional modules. The hardware structure of the system is shown in Figure 2.

3.1. STM32 control module
STM32F series is a low-end 32-bit ARM microcontroller. This series of chips are produced by ST company. Its core Cortex-M3 adopts the current mainstream arm v7-m architecture, with strong performance, low power loss and high cost performance. Stm32f103rct6 is an embedded microcontroller integrated circuit (IC). The core size is 32 bits, with the highest 72mhz main frequency, the program memory capacity is 256Kb, and the expansion function is rich. It can easily cope with the work of multiple modules. It mainly uses the control chip to design the peripheral circuit and realize the control of other modules.

3.2. Positioning module
There are large errors in the interference and accuracy of single satellite positioning. The dual-mode
positioning system makes full use of two sets of satellite systems to achieve positioning, the number of available satellites can be doubled, more positioning information can be obtained, and the positioning accuracy is obviously better than that of single satellite.

Satellite module adopts ATK-S1218F8-BD GPS / BeiDou module, which is produced in Xingyi electronic technology company, with excellent workmanship, refined materials and high technology level. Its core fabrication is the S1218F8-BD module, which is produced by skytraq. Is a high-performance module.

Its characteristics are as follows: (1) good performance, light weight, small size, easy to carry. (2) Parameters can be set through serial port, which is convenient to use. (3) With IPX interface, antenna can be connected. The antenna is active to ensure the signal accuracy. (4) The module can support 3.3v/5v two kinds of power supply to use, with its own backup battery, which can ensure that the relevant data is still maintained when the power is off.

3.3. Display module
The display module adopts 2.8-inch TFT LCD, which is widely used in industrial control field and has strong anti-interference ability. Toughened glass is used for high safety. The resolution of the module is 320 × 240, working voltage: dc3.3v, working current: 85mA (max).

3.4. Power module
The power module is responsible for the power supply of the whole system. Because of the different working voltage of each module, different voltage output needs to be designed. The system mainly uses lm2576 step-down switch voltage stabilizing chip to build the protection circuit. The chip can drive the load of 3A current at most, and the standby current is only 50 μa, which has the advantage of low power consumption. It can reduce 12V voltage to 5V and 3.3V voltage output, which can fully meet the working requirements of other modules. The above is the main reason why the power module chooses the chip. The circuit principle of the system is shown in Figure 3.

4. Software design
The software design of the system is mainly divided into two parts, which are GPS / BeiDou positioning module communication part and display part.

The communication interface between atk-s1216f8-bd GPS / BeiDou module and external equipment is UART (serial port), the output BeiDou/GPS positioning data is NMEA-0183 protocol (default), and the control protocol is skytraq protocol. The system program flow chart is shown in Figure 4.
5. System test
Based on the above design, a real object is made and the system is tested. The display screen can display longitude, latitude, altitude, speed, positioning mode, number of visible GPS satellites, number of Beidou satellites, date, etc. the display result is shown in Figure 5.

![Figure 5 Information display](image)

In a word, through many tests, the positioning accuracy of the system depends on the parameters of
the chip, which can meet the design requirements.

6. Conclusion
In this paper, the design of agricultural machinery positioning and monitoring system is completed. The controller adopts high-performance stm32f103rc6, the satellite module adopts Beidou + GPS dual positioning module, and the display screen displays longitude, latitude, height, speed and other parameters. Through the use of modular design, the power consumption is effectively reduced, the volume is reduced, and it has a certain degree of portability. The design can realize the positioning monitoring of agricultural machinery, improve the precision of agricultural machinery operation, and also can be used for agricultural machinery operation statistics, management and scheduling.

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