

Design of Intelligent Water Control System for Concrete Mixture in Winter Construction

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ABSTRACT. *This article uses microelectronics STM32F103 as the main control chip to construct an intelligent water control system. Its performance is greatly improved compared with ordinary water use systems. The various functions of the chip can easily complete the system work of the solar water control circuit. , The overall system adopts a modular design, and systematically realizes real-time water level monitoring, water level control, automatic water supply, real-time water temperature monitoring, water level alarm and other functions. These functions are in line with the product positioning of the intelligent water control system and have a specific construction process.*

KEYWORDS: *Embedded System; Single Chip Microcomputer System; Intelligent Water Level Controller; Control System; Water Level Control*

1. Introduction

In winter concrete construction, in order to increase the temperature of the concrete mixture and prevent the early freezing of the concrete, it is necessary to heat the mixing water, but excessively high water temperature will cause the “false setting” of the cement and affect the normal setting and hardening process of the concrete. Early strength development of concrete. Therefore, when mixing concrete in winter, the temperature of the mixing water must be strictly controlled. When using ordinary Portland cement less than 525 and Portland slag cement, the temperature of the mixing water should be controlled within 80°C; when using Portland cement and ordinary Portland cement greater than 525, the mixing water The temperature should be controlled within 60°C. With the development of science and technology and the advancement of human industrial capabilities, more and more construction environments require intelligent factors. The concrete mixture

requires an intelligent water control system. As a new type of low-carbon, environmentally friendly and low-energy water use system, this system has been quickly promoted during the construction process, saving a lot of energy consumption in my country, so intelligent water control The market prospect of the system is relatively broad.

At present, the mainstream water control system [1] includes a display module, a water temperature and water level monitoring module, with automatic water filling function, and basic functions such as an alarm when the water level is exceeded. It uses a digital tube to display content and uses the main control chip function. Simple, can only support relatively simple hardware systems, and can no longer keep up with the pace of current industrial development.

2. System Design Scheme

2.1 Working Principle of Intelligent Water Control System

The intelligent water level control system mainly monitors the data of the water level sensor through the single-chip microcomputer, and dynamically adjusts the water level in the water tank according to the real-time water level data of the water level sensor. The water level and water temperature data are displayed on the LCD screen, and the single-chip microcomputer judges whether the water level exceeds the user setting in real time. Set the water level. If the water level exceeds, an alarm will be issued. When the water level is insufficient, the water pump will be driven to automatically feed water to achieve automatic control of the water tank level.

2.2 System Scheme Design

The design content of the intelligent water control system is roughly divided into: main control module design, sensor module design, display module design, automatic water supply control module design, alarm module design, etc.

(1) Design of main control module. STM32F103 series single chip microcomputer is used as the main control chip in this paper. Various external devices can be easily integrated into THE STM32 system for control.

(2) Design of information display module. At present, most water level controllers can only display fixed text content with limited content richness by using digital tubes. TFT3224 LCD can display customized color image content within 320*240 pixels, which can be set at will to display rich information content.

(3) The selection of sensor module. This paper selects a resistor-type integrated water temperature/water level sensor specially used for solar water heater.

The sensor its advantage is waterproof, high temperature resistant, is a mature sensor module, the use of water conductivity, decorate in the sensor bar four position four resistance, in the bar dry the water level sensor output voltage between

the two wires to $60\text{ k } \Omega$, when the water level reaches testing point, within the current will be conducting rod with enclosure, check point resistance was short circuit, the resistance value will change, the sensor of the temperature measurement module, is the use of thermal resistor, when the temperature rises, the resistance to change, you can easily determine the change of water temperature, structure as shown in figure 1.

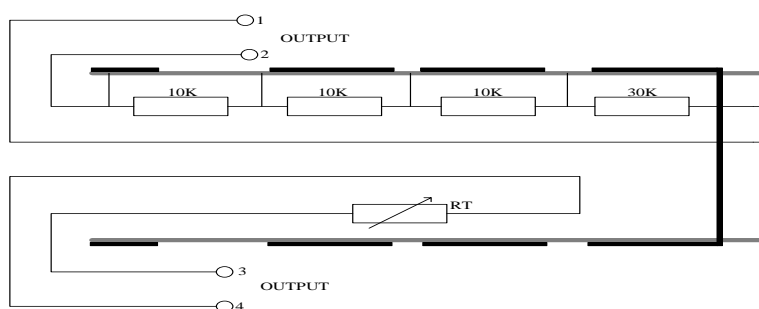


Figure. 1 Structure diagram of integrated water level/water temperature sensor

3. Unit Modular Design

The main control chip of the hardware system determined by this system is STM32F103VET6, which uses its IO interface to drive the TFT3224 LCD screen module, and its own ADC module [2] can conveniently process the voltage signals from the water temperature and water level sensors, and use the IO port to control The buzzer reaches the alarm function, and the IO port control relay is used to realize the control function of the water pump.

3.1 Design of SCM Control System

The minimum system of STM32F103 series [3] mainly includes power supply module, clock circuit module, external reset module and serial port burning and writing module, etc. Its circuit system is relatively simple.

Using the special water level, water temperature sensor as the sensor module, the sensor voltage data received by single chip microcomputer on ADC, modulus conversion, single-chip microcomputer real-time query AD transform the result of [4], transform the AD out of the water level, water level data real-time display on the LCD screen, the user can through the buttons to water level set, according to the water level set by the user, the system will automatically determine whether lack water, through the relay drive pump automatically sheung shui, exceeds the level system will drive buzzer alarm. The control system framework is shown in Figure 2.

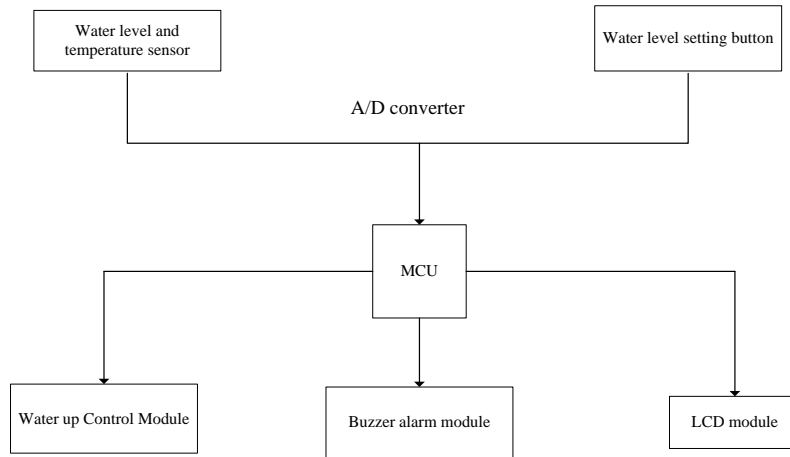


Figure. 2 Framework diagram of intelligent water control system

3.2 TFT3224 LCD Module

The display module used in this system is TFT3224 LCD [5], which is a 256 color screen with a resolution of 320*240. The display adopts parallel bus mode for communication, which can be easily controlled by THE IO port of STM32F103 and operated by 8080 timing sequence [6]. The timing sequence of the bus is shown in Figure 3.

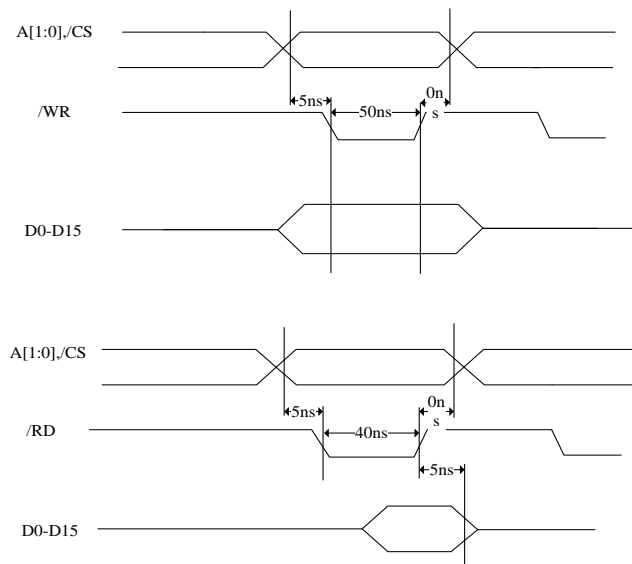


Figure. 3 TFT3224 LCD screen operation timing diagram

The LCD screen and the STM32F103 chip need 13 data lines, a power line and a ground wire. The 13 data lines select 13 adjacent IO ports for connection according to the physical pin positions of the chip, which is convenient for later wiring. So I chose PB13-15, PE14-15, PD8-16 13 adjacent IO ports to control the TFT3224 LCD screen.

3.3 Water Temperature and Water Level Sensor

The integrated design of resistive water temperature and water level sensors can greatly simplify the design of hardware circuits. The water temperature sensor is connected in series with a 10K resistor to divide the voltage, and the ADC can read the voltage value on the water temperature sensor to determine the water temperature data. In the actual measurement of the water level function, the water level sensor has not been able to work stably, using its principle [7] A self-made water level sensor is used, a plastic board is used as a fixed board, a long copper wire is used as a power supply line to provide 3.3V voltage, four short copper wires are arranged on the board as water level monitoring points, and a simple version of the water level sensor is finally made. When the water level covers the detection point, the 3.3V voltage of the power supply line will be conducted to the adjacent water level detection point. If the ADC input detection point voltage is higher than the threshold voltage, it can be considered that the water level has reached the detection point and reached the real-time water level monitoring. Features.

3.4 Buzzer Alarm Module

The system can control the buzzer by controlling IO port driving triode according to the water level alarm condition. This design USES active buzzer and outputs high level to the buzzer to drive the buzzer to work.

3.5 Relay Control Module

This design involves the water pump control module, so you need to add relay control [8] the pump work, control circuit, composed of single chip microcomputer through IO mouth and triode can control relay switch, to control the start and stop of the pump, the design USES the zero relay as control module, which can take advantage of the low voltage signal voltage as control end control of a high-power electrical module.

4. System Test and Result Analysis

Water level monitoring function test when will the water level sensors, test the water to soak in water level sensor testing point is displayed on the LCD panel when

the water level of the real-time data, when the water level exceeds the threshold level of the set will see a buzzer alarm, when water less than a threshold level to see if the relay module control pump work.

First of all, the press of a button, adjust the threshold level of 25, will be submerged water level sensor, LCD screen can real-time display the current water level data, keep the water level in the position of 0, relay, control instead of the pump light bulb lights up, on behalf of the water pump to work properly, after whole submerged water level sensor, water level shows that 100%, buzzer alarm, lights out at the same time, on behalf of the water level more than the set value.

The water temperature sensor was dipped into the bucket and waited for a while to display the temperature of 26°C. Compared with the value of the reference thermometer, the result was also in line with the real temperature. The temperature conditions were changed several times and the test results were all in line with the value of the reference thermometer. The test result is showned in Figure 4.

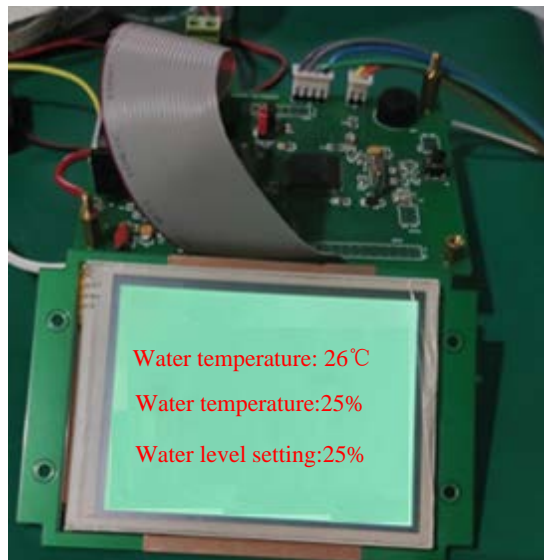


Figure. 4 Results of the intelligent water control system

After the test, you can see the design of intelligent water control system works well, basically meet the design requirements, the system can real-time monitor the tank water level, water temperature data, at the same time can real-time feedback to the operation of the user to make both the requirements of low power consumption, after testing in the regulated power supply, work only 1 or 2 W power consumption.

4. Conclusion

According to the actual demand to design the intelligent water control system based on STM32F10, the chip integration, high stability, reliability, low power consumption at the same time, the system USES a TFT3224 LCD screen as the display module, compared with the traditional solar water heater control system, the display content more rich, combined with the water temperature, water level sensor, buzzer, relay module to complete the function of water level control, etc.

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