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Design of Aquaculture Environment System Based on Remote Communication Technology

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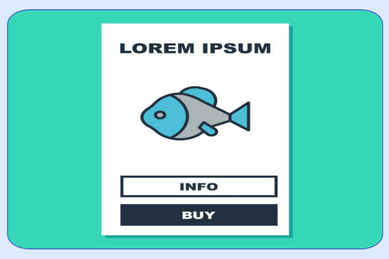
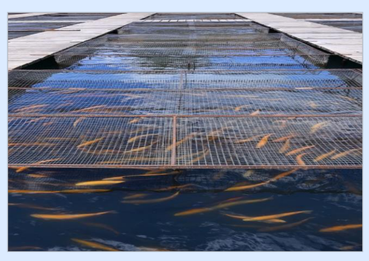
1. Introduction

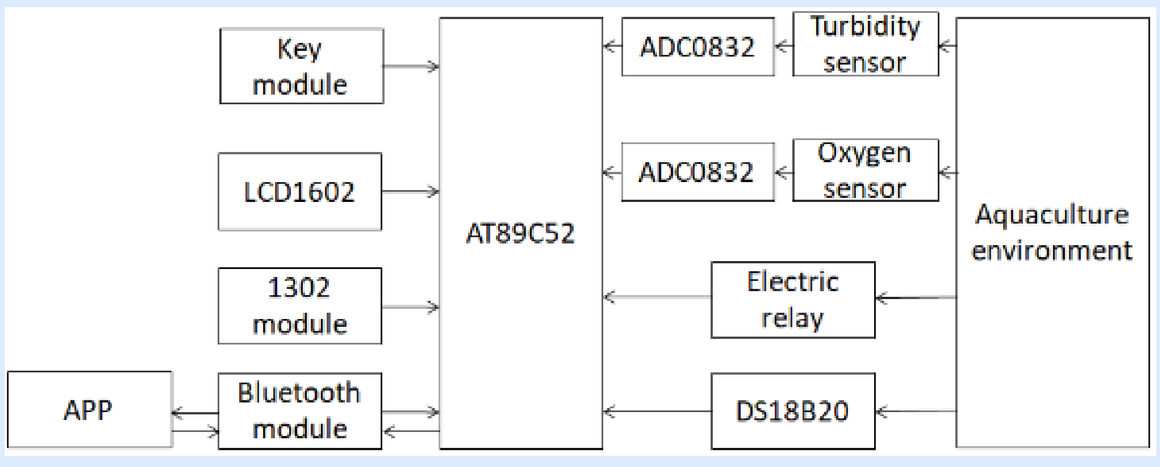
Since the reform and opening up, thanks to a series of strong support policies and wise development guidance implemented by the country, the livestock industry has achieved rapid and vigorous development. According to the latest data released by the Ministry of Agriculture and Rural Affairs, as of 2018, China's aquaculture industry has achieved remarkable success, with a total aquaculture output exceeding 50 million tons, accounting for over 78% of the country's total aquatic product production, demonstrating China's dominant position in the aquaculture industry[1-2]. The traditional artificial breeding model is gradually facing innovation, and the rise of high-tech breeding technology is becoming a trend. By utilizing advanced technology and equipment, real-time monitoring of water quality indicators in aquaculture environments is carried out, and relevant facilities and equipment are dynamically adjusted based on data feedback to ensure the creation of an optimized and continuously adapted aquatic ecological environment for aquaculture organisms to meet their growth needs.





2. System scheme design

The aquaculture environment system based on single-chip microcontroller combines redox sensors, turbidity sensors, and temperature sensors to detect the oxygen content, turbidity, and water temperature in the fish pond. Three independent buttons are used to change some parameter information of the intelligent fish pond system, such as dissolved oxygen threshold and turbidity threshold. When the oxygen content in the fish pond is below the preset threshold, the relay will be automatically turned on to simulate oxygenation. When the oxygen content is above the threshold, the relay will be turned off to pause oxygenation. The display module can display various parameters of the intelligent fish pond, such as current temperature information, dissolved oxygen information, turbidity information, and system time. Users can clearly understand the current dissolved oxygen value, temperature, and turbidity through the display module. Users can set the dissolved oxygen threshold and turbidity threshold through the button module according to their needs. By using a Bluetooth module to communicate with the mobile app, users can also clearly understand the current dissolved oxygen value, temperature, and turbidity in the mobile app. Users can also set the dissolved oxygen threshold and turbidity threshold through the buttons in the mobile app according to their needs. The structural diagram of the system is shown in following.



3. System hardware circuit design

The core controller of this design uses high-performance AT89C52 microcontroller, and DS1302 is used as the clock circuit. The P35-P37 pins of DS1302 clock chip are connected to the corresponding interface of AT89C52 microcontroller, which can provide real-time time for the system. When the microcontroller issues a data acquisition command, the temperature sensor quickly receives and executes it, monitors the water temperature in real time, and then finely processes the obtained data. Finally, the temperature signal in digital form is accurately transmitted back to the microcontroller for further processing and analysis. This design directly connects the 2nd output signal of the dissolved oxygen value detection device ORP to the analog input port of ADC0832, and then transmits the information to the communication module of the microcontroller through an appropriate interface. The No. 2 pin of the turbidity detection sensor of the aquaculture environment system is connected to another analog input interface of ADC0832, and a 10 kiloohm resistance is connected in series with the No. 2 output terminal at the VCC terminal, and then connected to the MCU to realize data transmission.

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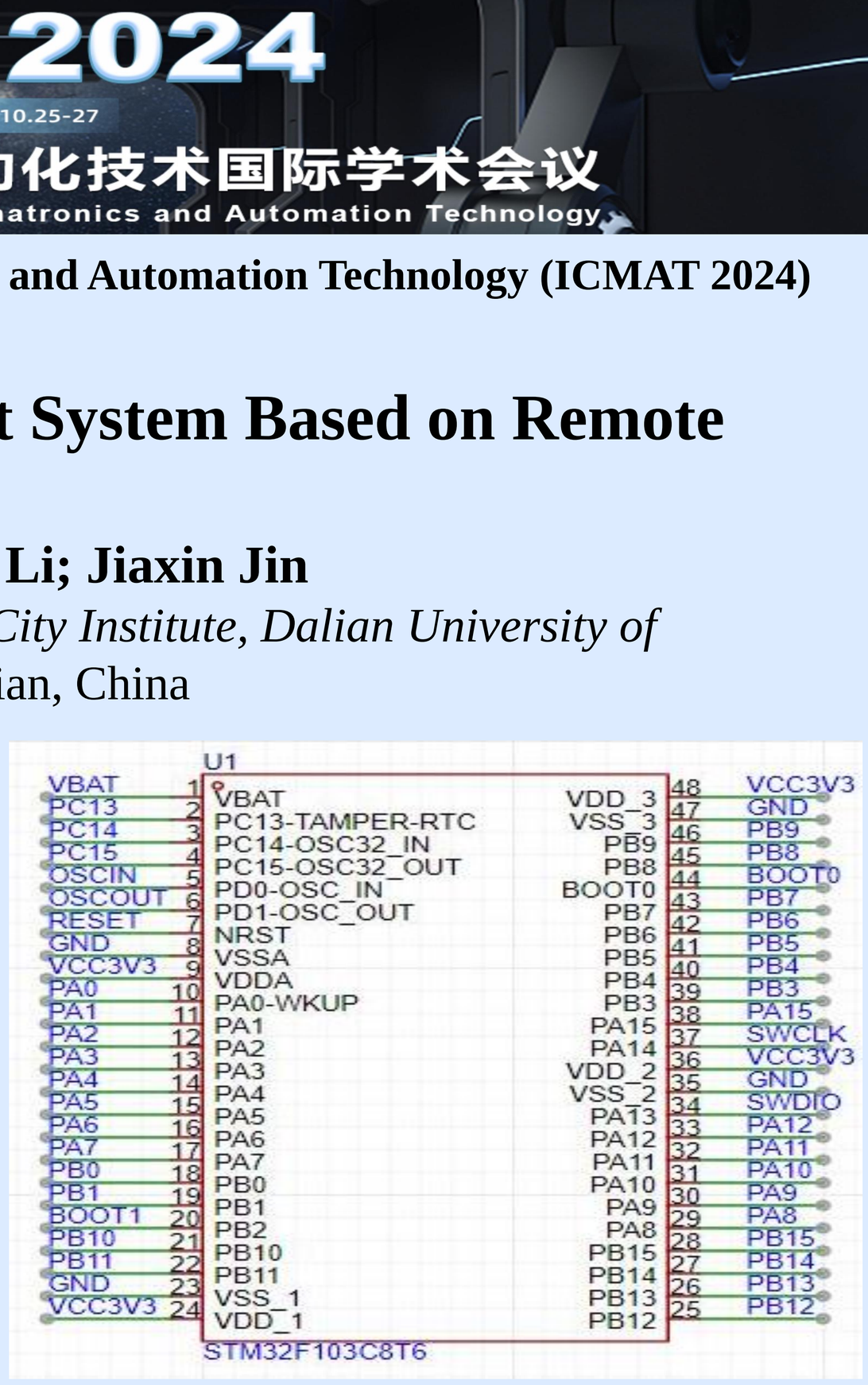
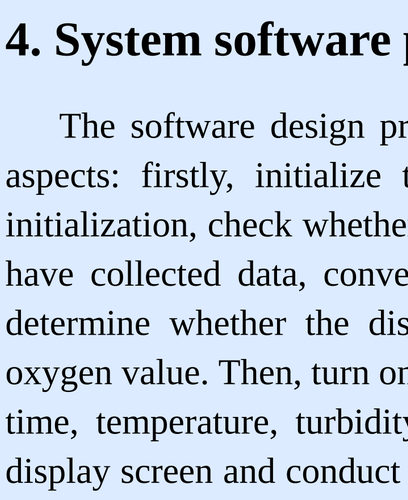
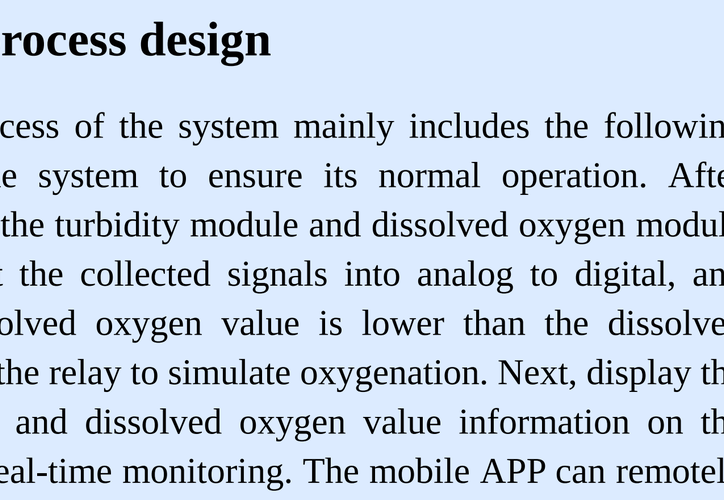


4. System software process design

The software design process of the system mainly includes the following aspects: firstly, initialize the system to ensure its normal operation. After initialization, check whether the turbidity module and dissolved oxygen module have collected data, convert the collected signals into analog to digital, and determine whether the dissolved oxygen value is lower than the dissolved oxygen value. Then, turn on the relay to simulate oxygenation. Next, display the time, temperature, turbidity, and dissolved oxygen value information on the display screen and conduct real-time monitoring. The mobile APP can remotely monitor in real-time through the Bluetooth module.

The aquaculture environmental system has a regulation mode that can adjust the time, dissolved oxygen threshold, and turbidity threshold to meet the different needs of users. According to the set threshold, it also has a power outage warning function, and the power outage information can be displayed in the mobile app. The monitor can display the system's data information in real time.





5. System Function Verification

The welding method used in this design is to directly use a soldering iron to solder and build the system circuit on the universal board. The PCB plate making diagram of the system is shown in Figure 3.

On the basis of the physical system, debug the key functions, temperature detection function, turbidity detection function, oxygen content detection and control function, and Bluetooth function of the system. The results of key function debugging are given and the results of detection and control function debugging are shown in following figures.