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Liquid Level Monitoring System Based on MCU Design

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Abstract
Based on single-chip microcomputer based design of liquid level monitoring system to monitor water levels, the system container for liquid level detection using a liquid level sensor signal detected and communicated to the MCU STC89C51 for processing. Under normal circumstances, remain within a certain range of liquid level, and position of the digital display level; when the level sensor fails, power off automatically and the buzzer sounded a warning signal. This system saves time and improves the overall efficiency of work.

Keywords- *MCU, sensors, liquid level monitoring, digital display*

I. INTRODUCTION

Liquid level monitoring is a key factor in fluid control, with the development of network technology, embedded technology and intelligent sensor design based on single-chip microcomputer control system, through the automatic data acquisition, will set the value and the acquisition value, remote monitoring of liquid level, networked, intelligent fluid control can be achieved [1]. Liquid level measurement is a key factor in fluid process control, the container level related to the safety of the person, device. Liquid level monitoring is widely used in daily life and industrial fields, such as hydropower stations, water towers, water level control in such situations. In all issues relating to energy, the container is an essential device, directly related to the safety of containers of liquid level control, or even related to production safety and efficiency. Liquid level control has an extremely important significance.

II. SYSTEM DESIGN

Liquid level controller based on single-chip has been developed, but its depth, there is considerable room for development. Its main technology STC89C51 single chip microcomputer PID algorithm using single chip computer and buzzer, liquid level sensors, devices design [2]; microcontroller into signals for data processing, level display on LED digital tube, beyond the level line through the buzzer alarm. By installing the pressure sensor in the pump outlet pipe and the export into standard industrial signal of analog signals, through the preamplifier, multiplexing, a/d converters and digital signals onto a single chip, SCM comparison for a given parameter and calculating, PID calculations, adjusted parameters [3]. To surge through the d/a converter/frequency conversion enter given port, adjust the motor speed, control the output voltage changes in water level in the control tower. System design is shown in Figure 1:

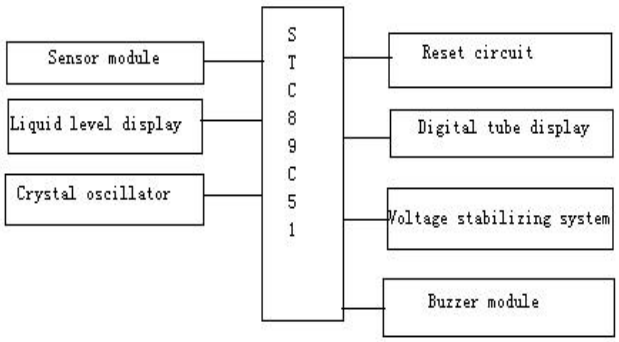

Fig.1. liquid level monitoring system

III. HARDWARE DESIGN OF CONTROL SYSTEM

Liquid level controller based on single-chip STC89C51 chip is at the core, sensor modules, liquid display module, crystal oscillator circuit, reset circuit, digital display module, the system voltage regulator modules, buzzer module.

A. STC89C51 single chip microcomputer module

Central processing unit is the whole system of data analysis and processing centre, undertaking the data into the output and processing, the data shows the drive and turn on the alarm and relay responsibility of electronic valve. CPU options should carefully consider the price, stability, ease of operation, and many other factors [4]. Command, central processing unit CPU is a single-chip implementation Center, which read and write procedures and instructions are executed, as shown in the following Fig 2:

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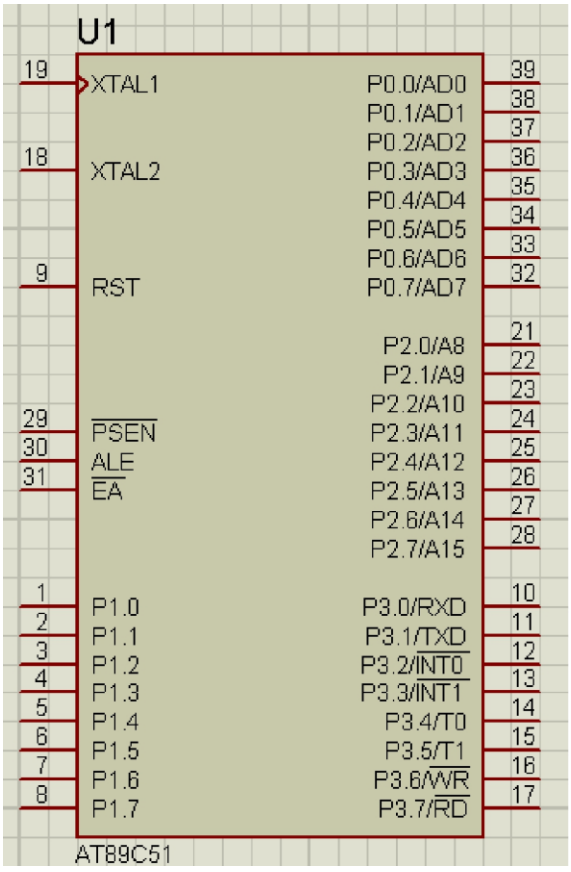

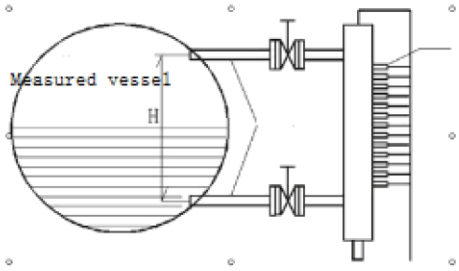

Fig.3. water level sensor module

B. Level display module

This system uses the digital display different levels of liquid level, seven-segment digital tube is the most commonly used display devices, and has the advantages of low cost, easy to drive [6], which consists of 7 pieces of LED diodes and LED

a decimal point, and formed a "day" style, digital control common cathode, or common anode. But its methods and working principle is basically the same. Digital signal obtained by decoding circuit connected to the corresponding LED light-emitting diodes to form the corresponding digital signals. Due to microcontroller reset pin high, so we use a common anode led displays. As shown in the figure for common anode led.

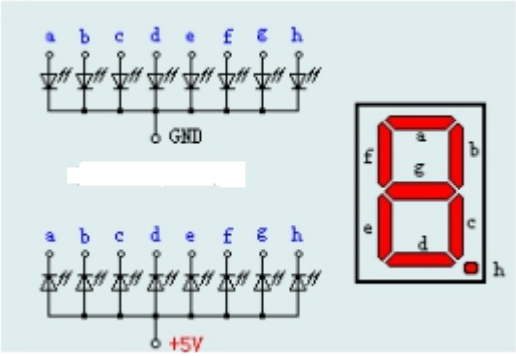

Fig.2 sketch of STC89C51 pin

C. Electric contact all SST sensor module

For conductive liquids, the most convenient is to use electrical conductivity sensors, relatively speaking, have very high accuracy and reliability, Potentiometric sensor is the simplest. When the liquid in the container is in a different level, through the conductivity of a liquid conductor connected electrodes [5]. The microcontroller input signals are not the same, you can achieve the exact purpose of the input signal. Here to say remove the conductive liquid liquid metals and salts, acids, alkaline liquid, also contains non-pure water in industrial production processes. For example in the high and medium pressure boiler water, even the boiling water, its resistivity is very few to dozens of European meter range, it is conductive enough to cause the change of sensor input. For this system, using the conductivity of the water, direct currents of "pass" or "off" to determine if water reaches the water line, as shown in the following Fig 3:.

D. Clock circuit design module

TC89C51 single-chip clock generator in two ways, one isinternally generated and produced by chip internal oscillator circuit; other is external [7]. This system according to actual need and using simple, used through chip internal oscillation of work way, STC89C51 single tablets machine internal has a used to constitute oscillation module of high gain anti-phase zoom circuit, introduction feet XTAL1 and introduction feet XTAL2 respectively is this zoom circuit of entered port and output port this zoom circuit and as feedback components of tablets outside Crystal or ceramic resonance device common constitute has since stress oscillation device. Capacitors C1 and C2 and an external crystal oscillators constitute a parallel resonant circuit in the amplifier circuit of feedback loop, oscillation frequency of the oscillator stability as well as high and low temperature stability and accuracy will start fast under the influence of capacitance.

current is very small, it is difficult to drive the buzzer. External driver circuit. As shown in the figure:

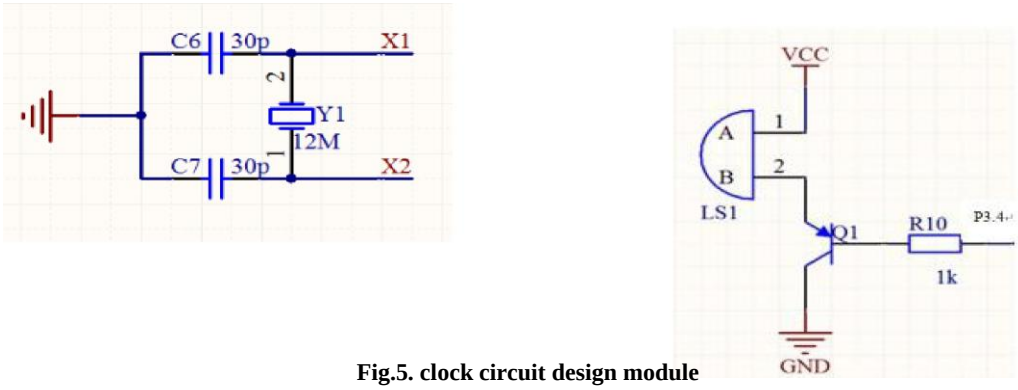

Fig.5. clock circuit design module

E. Design of reset circuit module

This button is used to reset the system [8]and provides reset signal when the system is powered on, until the system reaches steady state conditions, cancel the reset signal. To prevent switching time jitter effect signal accuracy, so after a certain delay to cancel the signal. STC89C51 the RST pin can make programs start executing commands from the specified location. As long as the RST pin two consecutive cycles of high level, you can have a reset action. If RST remain high, microcontroller constant reset until the RST on the low level implementation procedures from the 0000H address.

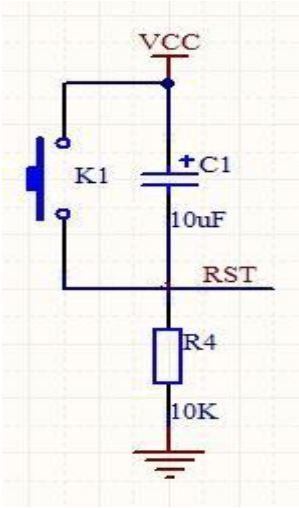

Fig.6. reset circuit design module

F. Automatic alarm module

Automatic alarm system alarm occurs in two situations:

- when the container when the liquid level reaches the maximum limit of liquid level alarm, level reaches the upper limit level system buzzer alarm.
- when the container when liquid level reaches the lower limit level alarm, buzzer alarm when it reaches the lower limit water level the water level system [9].

Buzzer is the use of an electric current through the coil creates a magnetic field, driven by the magnetic field diaphragm and produces sound. So must meet current value can make the buzzer, while common microcontroller output

G. System voltage regulator module

The main function of this module is to input level signal stable transmission from the sensor onto a single chip, is composed by the PNP transistor 8550, resistance. The circuit's main function was transferred from the sensor input level signal stable MCU internal, regulator circuit is mainly composed of transistors and resistors. As shown in the figure:

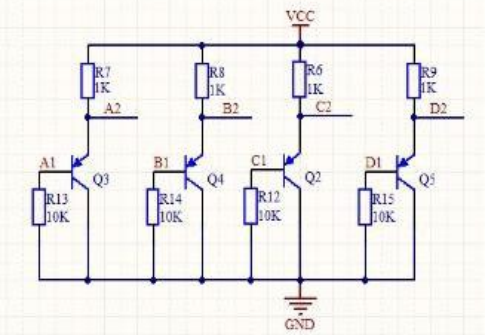

Fig.8. System stable pressure module

IV. SOFTWARE DESIGN AND SIMULATION OF CONTROL SYSTEM

A. Software design of control system

Program is shown in the following figure: the system begins to work, by sensor detects water depth, into single-chip compared to the set value. If the measured value exceeds the upper limit value alarm and close the pumps if the measured value is below the lower limit value alarm and starts the pump supply; if the measured value is equal to the set value the close pump stop water supply and water level values are displayed by, otherwise start the pump continue to water supply and water level values are displayed

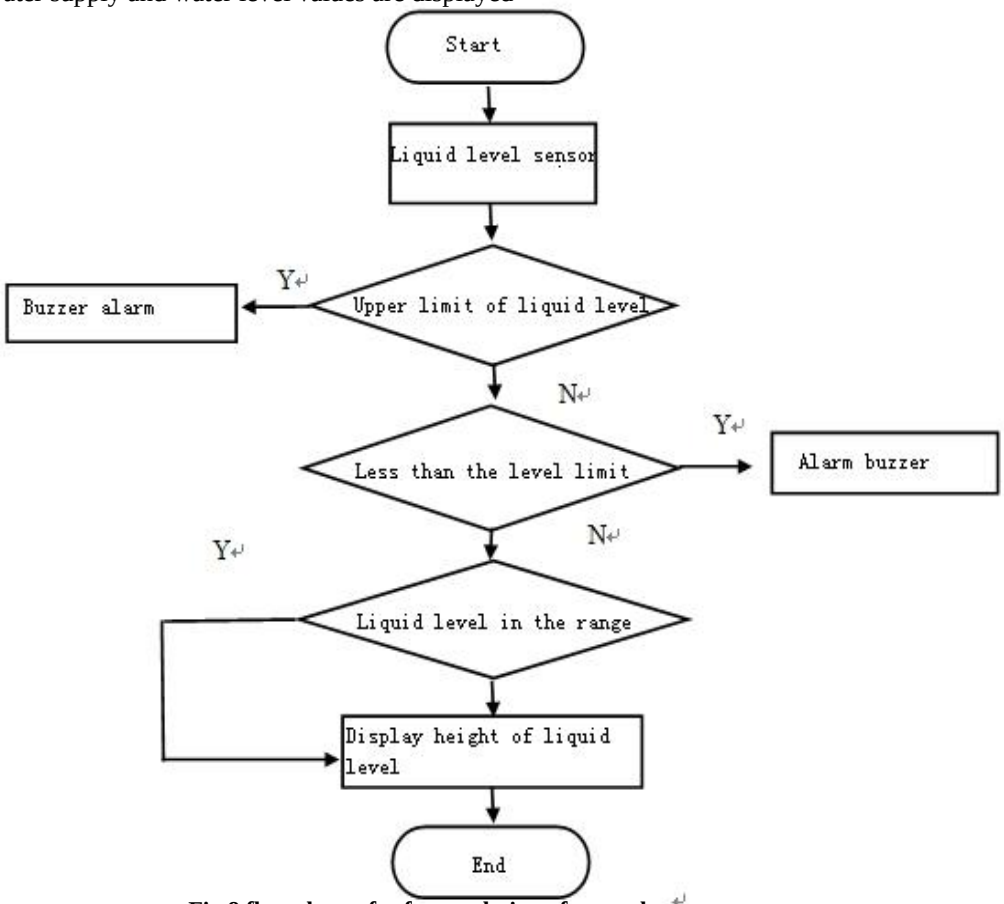

Fig.8 flow chart of software design of control system

B. Simulation of control system

After the completion of the hardware and software design, it is also required by the software simulation to verify the function of the system to achieve. In this design will use the Proteus software to simulate and verify, Proteus software not only has the function of simulation, but also can simulate the MCU and peripheral devices, is the best tool for microcontroller and peripheral device simulation. Proteus is one of the most famous simulation software in the world. It is the whole process from the concept to the product.

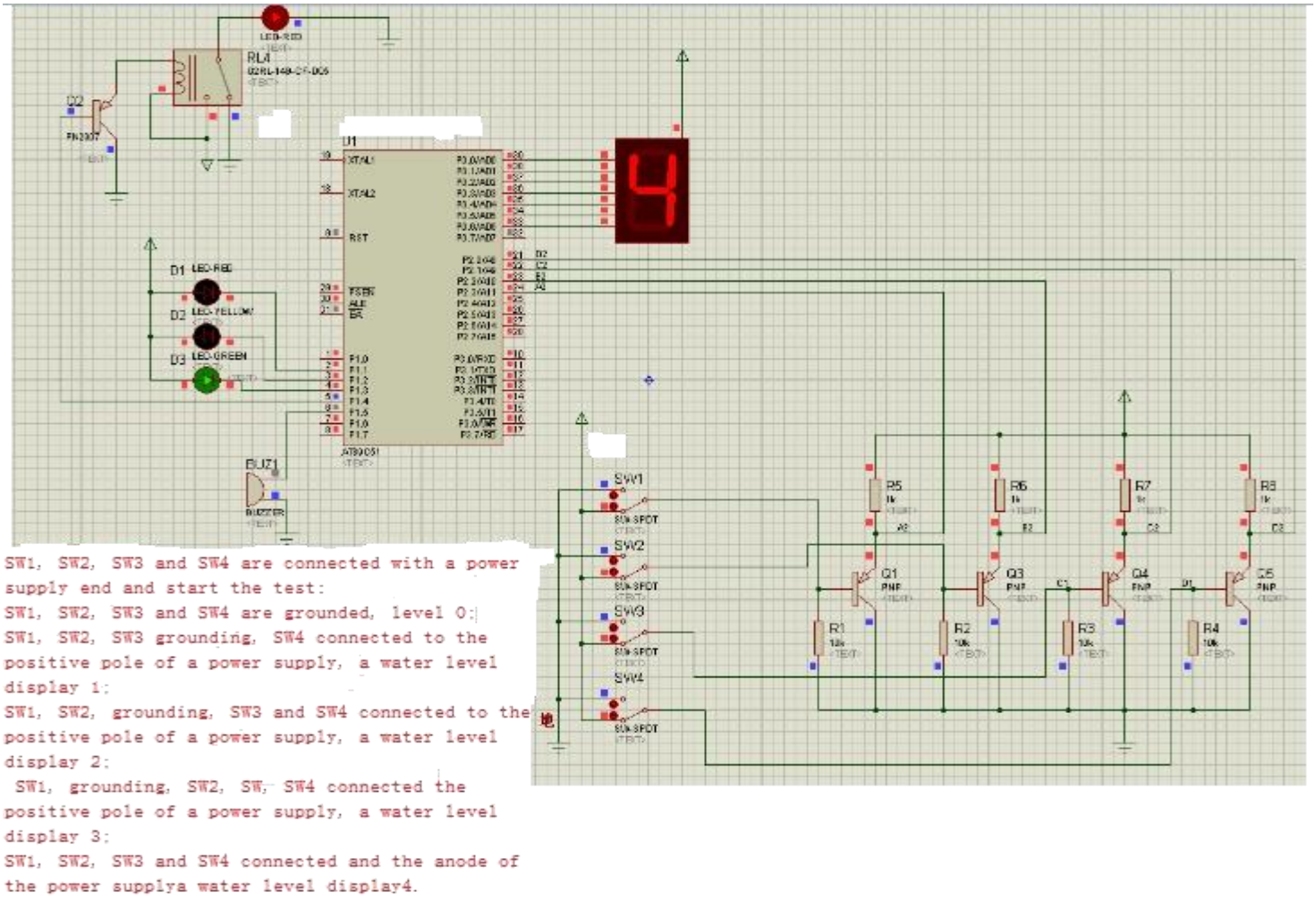

Figure 8 Simulation of liquid level monitoring system

Below are obtained by simulation and measurement data

For the first time on the use of electricity, let SW1, SW2, SW3 reconnected with a power supply end and start the test: SW1, SW2, SW3 and SW4 are grounded, level 0;

SW1, SW2, SW3 grounding, SW4 connected to the positive pole of a power supply, a water level display 1;

SW1,SW2,grounding,SW3 and SW4 connected to the positive pole of a power supply, a water level display 2;

SW1, grounding, SW2, SW, SW4 connected the positive pole of a power supply, a water level display 3;

SW1, SW2, SW3 and SW4 connected and the anode of the power supply, a water level display 4;

Table 1 comparison between simulation results and actual measured values

Display values	0	1	2	3	4
Actual measured values	0	1.2	2.1	3.2	4.3

Data analysis shows that the Liquid level monitoring system simulation results and actual measurement values of similar design of liquid level monitoring system for success.

V. CONCLUSION

In this paper, the design is based on single-chip microcomputer as the core liquid level monitoring system design, which includes sensor module, liquid level display circuit, external crystal oscillator clock circuit design, reset circuit design, automatic alarm circuit, voltage regulator module, the is MCU control mode, which is the combination of hardware and software to realize the function of monitoring liquid level. To achieve uninterrupted measurement of liquid level, liquid level measurement, with monitoring, data recording and processing functions.

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