

Simulating PLC Control System Based on Multisim14

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Abstract—Multisim especially Multisim14's characteristics are summarized in the paper. And Holding Tank control system is an example. Simulating PLC control system in the Multisim is an efficiency method, not only it can save lab cost, but also it afford an convenient approach for learners and designer.

Keywords-Multisim; PLC; simulation circuit

I. INTRODUCTION

Programmable Controller is developed in 1969 by DEC, and is applied in production line of GM successfully. Because it can only do logic operation, so it is called Programmable Logic Controller(PLC). In the late of 1970s, with the development of electronic technology and information technology, PLC extend it's application from logic control by switch to digital control, become an electronic computer industrial control equipment really. But, it need some material objects in studying PLC, and the objects are bulky and expensive, buy all of them is difficult to an average lab. While Multisim afford an simulation method—ladder diagram, the method can solve the difficult.

II. MULTISIM SOFTWARE INTRODUCTION

Multisim is a circuit simulation and designed software based on Windows developed by NI, it can simulate circuit level not only, such as digital circuit and analog circuit and PLC control system, simulate system level but also, such as PLD and MCU, and at the same time ,it can co-simulate with LABVIEW and MATLAB, it's function is very strong. Multisim14 is the latest version.

A. Multisim'S Characters

Multisim afford a lot of functions for learner and designer.

1) Strong circuit-level simulation functions

Multisim afford nineteen component families and thousands of components. It's interactive simulation function allows change circuit's parameters, by the approach, we can study the circuit's performance. We can also set faults in the circuit to study the circuit' performance by the faults. Designer can use the ladder diagram to design an industrial control system, the control system is the same with the real industrial device. Multisim afford more than twenty virtual instruments, such as oscilloscope multimeter spectrum analyzer and so on. Excepting, we can design ourselves virtual instruments in LABVIEW, and import it in Multisim, so we can use the custom-built instrument in Multisim.

2) Strong Analysis Functions

Multisim afford twenty-four analysis functions, such as AC Sweep, DC Sweep, Parameter Sweep, Monte Carlo and so on. We can fully describe all the circuit parameters and circuit's dynamic characteristics.

3) Strong system-level simulation functions

MultiMCU is one of Multisim's embedded component, it supports the simulation of MCU. To many circuit design, the MCU is the core, so, the function of MCU simulation extends Multisim' application area from circuit-level to system-level. Multisim also can simulate VHDL module, the simulation result maybe a waveform or display devices.

B. Multisim14'S New Characters

Compared with early version of Multisim, Multisim14 improved some new characters.

1) Integrate Analysis Dialog Box

Separate analysis dialog boxes have been eliminated. The long list of analyses has been removed from the Simulate menu—access each analysis from the Analyses and Simulation dialog box.

2) Improved Probe'S Function

You no longer need to manually add variables for analysis on the output tab - just place a probe on the node where you want to take a reading, select the active analysis in the Analyses and Simulation dialog box and click the Run button in either the dialog box, or the Simulation toolbar.

3) Enhanced The Parameter Sweep Analysis Method

In order to allow the circuit work in normal state, It is important to set the components' parameter. In Multisim early version, we must set the parameters manually, while in multisim14, we can set some variables which indicate the component's parameter, so, we can modify the component's parameter by changing variables based on the circuit's real action.

III. SIMULATING PLC CONTROL SYSTEM BASED ON MULTISIM14

Multisim14 affords not only the relay module but also the controlled object module. The example of Holding Tank control system is followed.

A. The Holding Tank'S Working Principle

Holding Tank is one of the controlled object in Multisim14, as shown in Figure I . Open the Holding Tank's setting dialog, we can set the Holding Tank's parameters. The setting box as shown in Figure II .

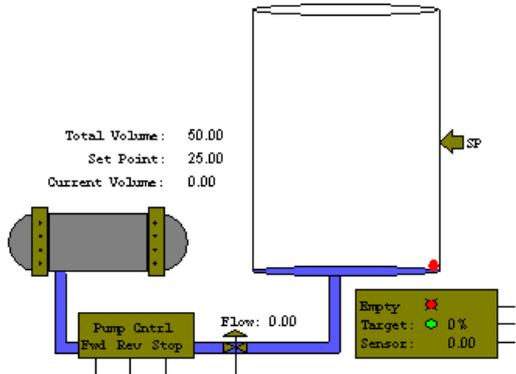


FIGURE I. HOLDING TANK MODULE

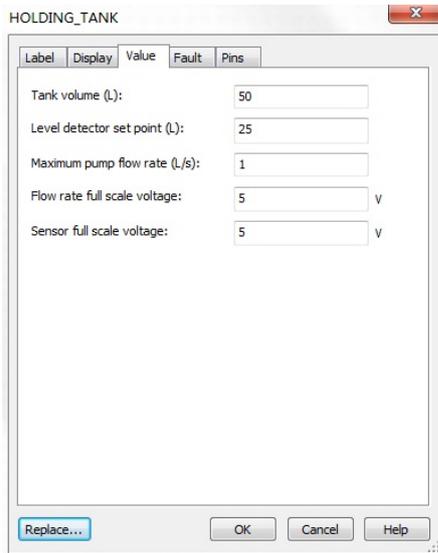


FIGURE II. HOLDING_TANK DIALOG BOX

Description of the parameters:

Tank Volume (litres):The max capacity, it's 50L in the example.

Level Detector Set Point (litres):The real capacity, it's 25L in the example, point out by "SP".

Maximum Pump Flow Rate (litres/second): The max flow rate when the Holding Tank is working.

Flow Rate Full Scale Voltage: The maximum of the flow rate, it's 5V in this example.

Sensor Full Scale Voltage: The maximum of the sensor voltage, it's 5V in this example.

B. Working Process Of The Holding Tank'S Control System

Open the circuit, shown in Figure III. Push the "Power" button, and then close the "Run" switch, the pump will water to the tank, the flow can be controlled. When the water arrive at the Level Detector setted, stop for 5s, and then the water flow out of the tan. When the tank is empty and close the "Run" switch, the pump water to the tank, like this again, until open the "Kill" button. The simulating process reflect the real control process. In Figure 3, the "U2" is the PLC's input device, "U3" is output device, "U1" is the controlled object. By programming the controller, the water in the tank can flow in or out automatically.

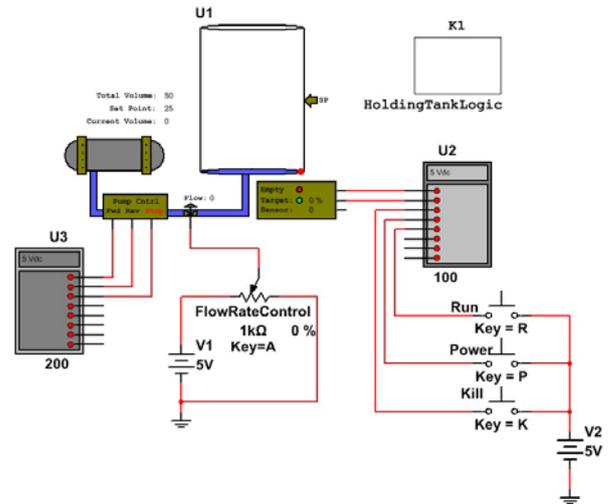


FIGURE III. HOLDING TANK CONTROL SYSTEM

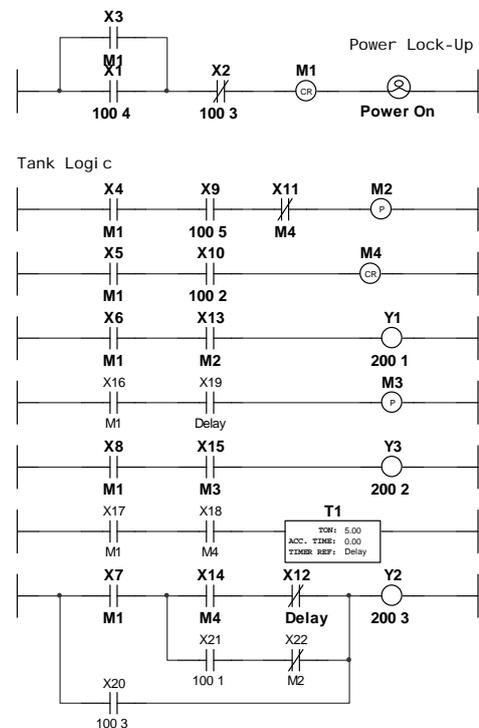


FIGURE IV. LADDER DIAGRAM

C. Ladder Diagram

The ladder diagram shown in Figure IV.

- 1) Push “Run” button, the simulation begin.
- 2) Push the ⟨P⟩ in the keyboard, the power inductor is lighted.

The contactor X1 in the ladder diagram controlled by input relay IN4. In the first-level, there is a self locking design, until push the ⟨K⟩ in the keyboard and shut off the power, the self locking is invalid. Self locking function as follows: Push the “power” button, contactor X1 closed, the coil M1 is electrified, and then the contactors’ state which related with M1 is changed, that is the normally-open contact “X3” closed, so “X3” replace X1, the self locking function is realized.

- 3) Push the ⟨R⟩ in the keyboard, the “Run” button is closed, the water flow in the tank.

When the water arrive at the Level Detector setted, delay for 5s, and then the water flow out of the tank until the tank is empty. The delay time can be controlled by Time Relay T. push ⟨K⟩ in the keyboard, we can shut the power anytime.

IV. CONCLUSION

The computer simulation software provides a new way for the circuit design and system optimization test. In Canada and America, more than 85% colleges and schools regard Multisim as experimental supplementary means. In our country, Multisim is introduced into classroom more and more widely. Especially, it give full play to the characteristics of intuitive, convenient, low cost and high efficient in the teaching of electronic technology and computer simulation, etc. Multisim14 further enrich component library, realize co-simulation with LABVIEW and MATLAB, extend the software itself function, wider the application range.

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