

# Application of proteus in Experimental Teaching and Research of Medical Electronic Circuit

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**Abstract.** The difficulties in teaching and experiment of medical electronics lie in the abstract and difficult understanding of the teaching contents, the lack of a good single-chip microcomputer software teaching platform support, we must innovate experimental means, combined with the actual needs of medical instruments and a large number of qualified application-oriented talents. Aiming at the problems in the experimental teaching and scientific research of medical electronic circuits, this paper puts forward the design and simulation methods of electronic circuits for medical instruments by using Proteus as a tool, and finally forms a series of schemes which can be applied to experimental teaching and scientific research.

## 1. Introduction

The difficulties of traditional electronics teaching and experiment lie in the difficult understanding of the teaching contents; the lack of effective links between courses; the lack of usage rate of experimental equipment; the lack of traditional experimental experiment content and programming; the lack of a good platform for MCU software teaching; the lack of comprehensive experiments and innovative experimental means [1]. It is difficult to train large numbers of qualified applied talents.

## 2. Method

### 2.1 Proteus

Proteus is a complete development platform from product concept to design completion. Its advantages are intelligent principle layout, hybrid circuit simulation and accurate analysis, single-chip software debugging, single-chip and peripheral circuit co-simulation, PCB automatic layout and wiring.

Labcenter, a British company and Proteus software developer, has been developed around the world for nearly 20 years. It is currently the most powerful and cost-effective EDA tool in more than 50 countries. It has been named the best EDA tool by EWW CAD REVIEW ROUNDUP [2]. It is one step ahead of other competitors in philosophy, continuous model development and software upgrade thus to ensure first-class technology.

Proteus software product structure as shown in the following figure 1, Proteus is a complete embedded system software and hardware design simulation platform, Proteus ISIS is an intelligent schematic input system, system design and Simulation of the basic platform to achieve the combination of single-chip microcomputer simulation and pspice circuit simulation. It has the functions of analog circuit simulation, digital circuit simulation, system simulation composed of single chip microcomputer and its peripheral circuit, RS232 dynamic simulation, I2C debugger, SPI debugger, keyboard and LCD system simulation, and various virtual instruments, such as oscilloscope, logic analyzer, signal generator, etc. ARES is a high-level PCB wiring editing software

[3]. The schematic diagram designed in ISIS can automatically export the network table after confirming that the device is packaged correctly. PCB layout and wiring can use 2D tools to design the PCB frame in the board Edge board side layer, set the wiring strategy, select the automatic or artificial device layout for wiring, and carry out DRC. (Design Rules Check) and ERC (Electrical Rules Check) can output Gerber files in layers for PCB boarding [4].

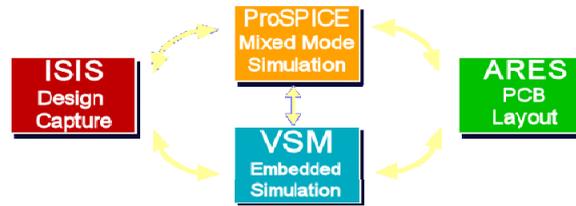


Fig. 1 Product structure diagram of Proteus software

Proteus virtual system model combines SPICE circuit simulation of mixed mode, dynamic device and microcontroller model to realize the complete collaborative simulation based on microcontroller design. For the first time, it is possible to develop and test such designs before the physical prototype comes out. Proteus software products include Proteus VSM, VSM for ARM7/LPC2XXX, VSM for 51/52, VSM for AVR, VSM for PIC24, Proteus PCB Design, Advanced Simulation Feature (ASF).

## 2.2 Development process

The traditional product development process is as following figure 2: firstly, the circuit diagram is designed, the layout of the circuit board is designed, and after a certain time there is a prototype, then the code is designed, the model is obtained by testing the layout of the board, the error of the prototype, the optimization of the code design and so that the model will be modified, so there will be some changes. The questions are as follows:

1. There's no physical prototype which could test the system.
2. It is difficult to debug software without system hardware.
3. It is very costly and time-consuming to remake the board.

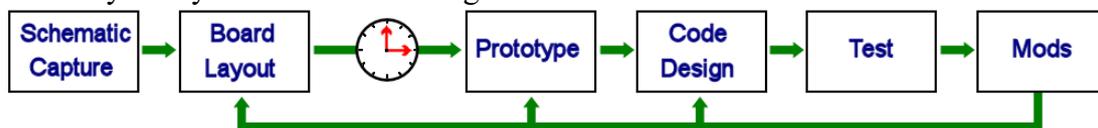


Fig. 2 Traditional product development process

The development process based on Proteus is shown in Figure 3. Before the model is determined, the design of circuit diagram, the coding and the system simulation can be completed on Proteus. The efficiency is improved. It is helpful to the layout of the board and the formation of the prototype.

1. As long as the schematic design is completed, it can be used for system testing.
2. The interactive simulation feature of Proteus enables software debugging and testing to be completed before the layout.
3. Hardware design changes are easy to change as software design changes.

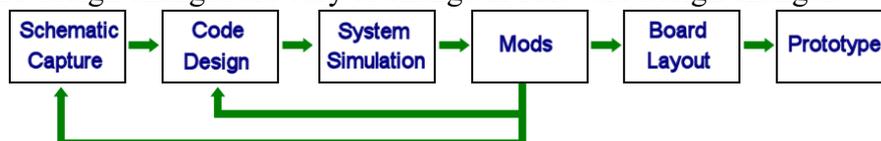


Fig. 3 Development flow chart of Proteus

## 3. Application

### 3.1 Application in Teaching

Proteus is a huge teaching resource, which can be used in the teaching and experiment of analog and digital circuits, microcontroller and embedded system software, integrated experiment of microcontroller system, innovative experiment and graduation design, project design and product development [5]. Table 1 illustrates the advantages of the Proteus virtual laboratory.

Table 1 Advantages of Proteus Virtual Laboratory

Hardware experiment	Proteus VSM experiment
Different hardware devices are needed for different experiments	Just a general computer
According to different CPU, it is needed to configure several expensive hardware emulators and different hardware environments.	Support a variety of mainstream CPU simulation, it can complete the whole embedded system simulation including CPU and peripherals.
It requires a lot of test equipment purchase and maintenance costs, and it also needs to buy various devices and consumables.	It contains 13 kinds of virtual instruments, the appearance is real, the function is complete, and more than 6000 optional virtual devices.
Mistakes made by students may lead to equipment losses or accidents.	Proteus VSM is a secure virtual environment.
It is not easy to configure corresponding experimental environment for changing software teaching contents.	It is convenient and quick to establish an experimental environment suitable for different software teaching.
Experimental teaching is limited to the laboratory, which is not easy for students to review and prepare after class.	Not restricted by geography, it is convenient for teachers to prepare lessons and students to learn, and it can also be used as multimedia courseware.
The recording of experimental results is more troublesome, which is not convenient for archiving and preservation.	It can print out quality drawings and reports, so that it can be easily archived and published.

Proteus is very suitable for skill evaluation and electronic competition [6]. It is necessary and difficult to evaluate the skills of single chip microcomputer. Proteus can provide all the resources needed for the test, directly evaluate the correctness of hardware circuit design, directly debug the software with hardware schematic diagram, verify the function of the whole design, and test controllable, easy to evaluate and easy to implement. There are widely practical used cases from proteus.

### 3.2 Application in Research

A Vsrc compound excitation source is designed and tested by Pspice under Proteus. It can be designed in the Medical electronic circuit charging circuit which is indispensable for outdoor first-aid medical equipment. Firstly, the symbol of compound excitation source is added to establish different types of independent voltage or current sources (DC, AC, TRAN). DC source assigns value to "DC =" directly. AC source assigns value to "AC =" as value and phase, and phase usage is expressed. TRAN source assigns value to "TRAN =" as TRA. The expression of the N source. The expression of voltage source and current source is the same, it only generates voltage or current. The circuit design is as follows:

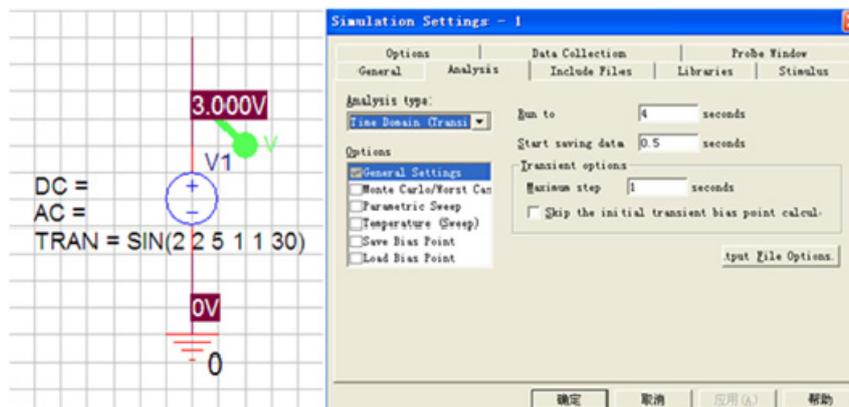


Fig. 4 Circuit design and simulation setting of VSRC compound excitation source

A simulation file is created to simulate a simple circuit with VSRC compound signal excitation source as sinusoidal signal excitation source. It can be seen that the sinusoidal signal excitation

source decreases steadily with the increase of time and meets the design requirements of the circuit, as shown in Figure 5.

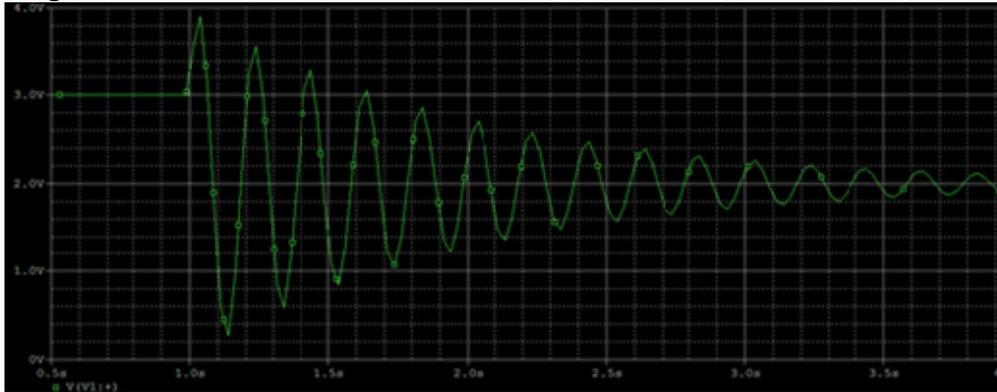


Fig. 5 Pspice simulation results

#### 4. Summary

In this paper, Proteus play as the core of the electronic circuit experimental teaching and scientific research solutions, innovative experimental means, combined with the actual needs of medical electronic circuit design, it is for the purpose of training qualified application-oriented talents to lay a solid foundation of medical circuit designing.

#### Acknowledgement

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