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Design and Implementation of Adder and Subtracter Experiments using Virtual Intelligent SoftLab

1Bhaskar Y. Kathane and **2**Pradeep B. Dahikar

1PCD ICSR, VMV College Campus, Wardhaman Nagar, Nagpur (MS), India
2Kamla Nehru Mahavidyalaya Sakkardara, Nagpur (MS), India
bykathane@rediffmail.com, pbdahikarns@rediffmail.com

Abstract– The scope of this paper includes study and implementation of Full Adder and Subtractor. A full-adder and Subtracter is composed with IC and virtual instruments. Along with the VIS model the designing, testing and debugging become easier. So, virtual Instruments are useful to design and implement the experiments. We use the binary code to represent numbers. In this research paper we have formulated how experiments on Full Adder and Subtracter are performed using the concept of virtual Intelligent SoftLab (VIS). Adder and Subtracter are constructed using the Virtual SoftLab and observed actual outputs. VIS helps us to create results using visual display. Software for conducting the experimentations in Adder and Subtracter has been developed which helps students to perform and practice the experiments. This will help students in understanding working of Adder and Subtracter.

Index Terms– SoftLab, Adder, Subtracter, Virtual Instruments and VIS Model

I. INTRODUCTION TO SOFTLAB

ELECTRONICS devices and the lack of resources make us unable to perform experiments, especially when they involve sophisticated instruments [1]. Web-based and video-based courses address the issue of teaching to some extent. Conducting joint experiments by two participating institution and also sharing costly resources has always been a challenge. With the present day internet and computer technologies the above limitations can no more hamper students and researchers in enhancing their skill and knowledge [2].

The SoftLab philosophy challenges us to link the physical laboratory experiment with its theoretical simulation model within a unified and interactive environment. The goal for each instance of a SoftLab laboratory is to create a software environment where experimental research, simulation and education coexist and interact with each other. As part of the SoftLab project, we are investigating the issues involved in the design and development of SoftLab Model for Electronics, Computer science and engineering. This paper describes how the SoftLab philosophy was used to design and implements.

The VIS forces us to address the challenge of solving experiments. Such systems require a wide range of expertise plus a flexible and diverse array of equipment. The SoftLab framework should provide the infrastructure and facilities that serve the needs for basic research.

The basic facilities include with VIS:

- High-performance graphics processors to support scientific visualization, and multimedia facilities.

- Software that allows application researchers to make full use of these facilities to evaluate their experiments without any risk.

- Virtual laboratories that provide scientists with a full range of functionality, both for experimental activities and for the mathematical modeling and simulation of the experimental processes.

The laboratory presents an ideal environment in which to accept and meet the challenges of computational science and engineering. Issues that must be addressed include mathematical software, electronic prototyping, geometric modeling, parallel algorithms, databases, software engineering, and computer systems. This facility is use for research in electronics, computer science and engineering Department.

In order to support the various activities that take place in a physical laboratory, scientists must be able to use the virtual laboratory to

- perform physical experiments by interacting with and controlling remote instruments,

- simulate physical experiments through computer modeling of the experimental process,

- compare physical and simulated data by playing back recorded experiments, and

- Train scientists to understand the physical experiment, the computational model of the experiment, and the relationships between them.

A choice of these four *scenarios* is available to scientists after they have selected their virtual laboratory at the SoftLab gateway. The graphical interface which is then presented to the user is a software representation of the physical laboratory. Each important physical device is present, in particular, all instruments and equipment used during the experimental process must have a visual representation in the virtual laboratory.

In the *virtual experimentation scenario*, scientists will set up the virtual instruments and experimental process just as in the physical scenario. Afterwards, the physical setup is transformed to the input required for the computational model. Additionally, parameters that are strictly numerical will be specified via special interfaces, and an expert system will be on hand to query for process characteristics or computational parameters. During the processing of the computational code, the virtual instruments will receive intermediate results so that they can be animated to show the progression of the simulation process. Results can be visualized exactly as in the physical case. The simulated experiment may also be saved to the experiment database. Here, too, the input configuration and output results will be used to define the experiment in the database. Since the physical and simulated experiments now reside together, computations on their associated data can easily be done for comparison or analysis.

VIS can benefit thousands of students and professors to learn difficult experiments [4]. The "Virtual laboratory" will bridge physical distance and availability of resources. Today it is possible to design good experiments among students for better learning.

VIS provides following benefits for Teachers:

- Visual experiments for lectures.
- Home Experiments for students.
- Virtual laboratory exercises in lab session.
- Opportunities for independent exploration for highly motivated students.
- Animated visualization for students in classroom.

VIS provides following benefits for Students:

- Experiment with electronics component safely and independently
- Supplement classroom exercises to improve understanding with electronics devices.
- Visual classroom laboratories at any place.

A. VIS Users

VIS can be used by:

- Colleges to perform practical using SoftLab
- Teachers will teach the student with different practical based concept.
- Research student perform their experiments with different devices.
- Students can read and perform their task in classroom.

Virtual Labs would helpful to students at the graduate level, postgraduate level as well as to research scholars. This would help them in learning basic and advanced concepts through Virtual Intelligent SoftLab (VIS) experimentation. This system provides a complete Learning Management system around the virtual Labs where the students can learn, observe and research the various tools. Video-lectures, animated demonstrations and self evaluation program available in future. This system also shares costly equipment and resources with visual effects. The functionality provided by this problem solving environment will therefore be:

- Collect the experimental data in real time.
- Provide visualization of the experiments.
- Control the experiment.
- Input the experimental data to the computational model.
- Control the computational model and visualize the numerical simulation solution.

SoftLab is such a flexible laboratory environment. Its goal is to simulate a laboratory space having a well-equipped storeroom of instruments and a variety of materials. Using SoftLab a student may be guided by an instructor to perform an experiment, or the student might also conceive of one on his own. The student may choose a substance to study, take out the instruments he needs, connect them together, make his measurements, and record and plot his results. The computer screen is the laboratory room. The experimental possibilities open to the student certainly are limited by the ability of the developers to maximize flexibility in a practicable way. Algorithms implemented so far have achieved the desired flexibility, and SoftLab has been well received [7].

The SoftLab philosophy challenges us to link the physical laboratory experiment with its theoretical simulation model within a unified and interactive environment. The goal for each instance of a SoftLab laboratory is to create a software environment where experimental research, simulation and education coexist and interact with each other in a seamless manner. Once this problem has been solved for a particular scientific environment, the design of the virtual laboratory can begin. In order to support the various activities that take place in an physical laboratory, scientists must be able to use the virtual laboratory to:

- perform physical experiments by interacting with and controlling remote instruments
- simulate physical experiments through computer modeling of the experimental process

II. ADDER/SUBTRACTER

The purpose of this SoftLab is to show you how to implement an adder using Quartos. As the name implies, adders are used to add two sets of values together. Adders are a very common design in digital design. For example, a CPU will use an adder to have its program counter point to its next instruction. This is done by adding a constant value of 4 to the current instructions memory address. You will be using adders both here. You will be shown Adder and Subtracter. The purpose is to show you how the virtual experiment perform with VIS model. You will learn why each is important as you go through this SoftLab. After creating our adder designs in Quartos, you will test your design on VIS Model.

We can connect full-adders as shown fig-1 and to add or subtract binary number with IC7483. The circuit is laid out from right to left, similar to the way we add binary numbers. The CARRY-OUT from each full-adder is the CARRY-IN to the next higher full adder. The numbers being processed are A3,A2,A1,A0 and B3,B2,B1,B0 and the answer is S3,S2,S1,S0 with 4-bit arithmetic.

During an addition, the SUB signal is deliberately kept in the low state. Therefore, the binary number B3 B2 B1 B0 passes through the controlled inverter with no change. The full adders then produce the correct output sum. They do this by adding the bits in each column, passing carries to the next higher column and so on.

During a subtraction, the SUB signal is deliberately put into the high state. Therefore, the controlled inverter produces the 1's complement of B3 B2 B1 B0. Furthermore, because SUB is the CARRY IN to the first full adder, the circuit processes the data in 2's complement of B3 B2 B1 B0 because 1 is being added to the 1's complement B3 B2 B1 B0.

```
        ADDITION                SUBTRACTER
         SUB = 0                  SUB = 1
      A3 A2 A1 A0              A3 A2 A1 A0
     +B3 B2 B1 B0             -B3 B2 B1 B0
      S3 S2 S1 S0              S3 S2 S1 S0
```
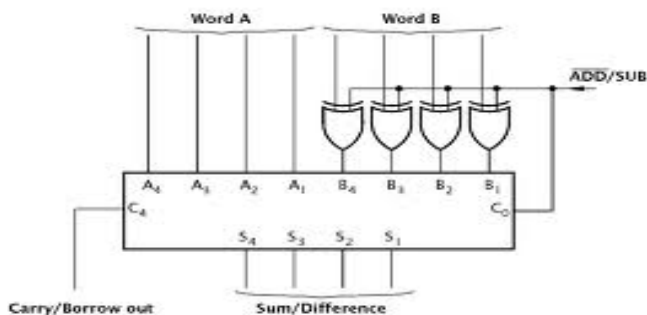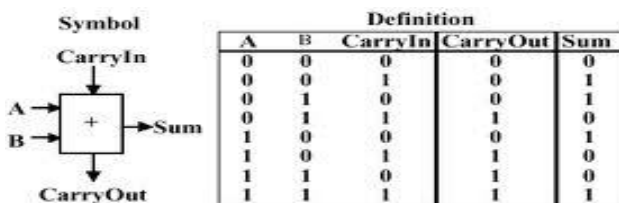

Fig. 1. 7-Adder/Subtracter

Fig. 2. Symbol and Truth Table

The main difference between a half-adder (HA) and a full-adder (FA) is that a full adder takes 3 inputs rather than 2. A full adder can add the same two input bits as a full adder PLUS an extra bit for an incoming carry. This is important for cascading adders together to create N-bit adders. Before we cascade adders together, we will design a simple full-adder. This model converts two rotations A and B into their sum A+B and difference A-B. This is useful for various applications.

III. TOOLS AND TECHNOLOGY

Visual Basic is a third generation event-driven programming language and integrated development environment from Microsoft for its COM programming model. VB is also considered as relatively easy to learn and use programming language, because of its graphical features. Visual Basic was derived from BASIC and enables use of graphics user interface, access to database and creation of ActiveX controls and objects. A programmer can put together the component provided with Visual Basic itself to develop an application. The language not only allows programmers to create simple GUI applications, but can also develop complex applications. Programming in VB is a combination of visually arranging Component or control on a form, specifying attributes and actions of those components. Visual Basic can create executables (EXE files), ActiveX control or DLL files, but is primarily used to develop Windows applications. The beauty of this model is that it does not require the Database to manage data [5].

IV. VIS MODEL

Circuits that can perform binary addition and subtraction are constructed by combining logic gates. These circuits are used in the design of the arithmetic logic unit (ALU). The electronic circuits are capable of very fast switching action, and thus an ALU can operate at high clock rates.

We have constructed the programs in Microsoft Visual Basic such that all the blocks in the model can be fully visualized on the screen. This model can demonstrate the activities of Adder and Subtracter visually. Inputs accepted throw software and virtual output will observe on screen. In an experiment we can provide different input values and observe output. This model provide circuit connection facility to user to made connection properly otherwise the result not generated.

A. Design Specifications

Here we need IC7483 to construct logical circuit to perform addition and subtraction. Adder and Subtracter required Input switches, Outputs LED, Virtual wires, AC and DC power supply. The connections are made as per standard circuit and observer outputs based on inputs. Add/Sub switch set the input to perform Adder and Subtracter operation accordingly.

Following figures Viz. Fig. 3, Fig. 4, Fig. 5 and Fig. 6 show the concept of Adder and Subtracter based on simulation technique.
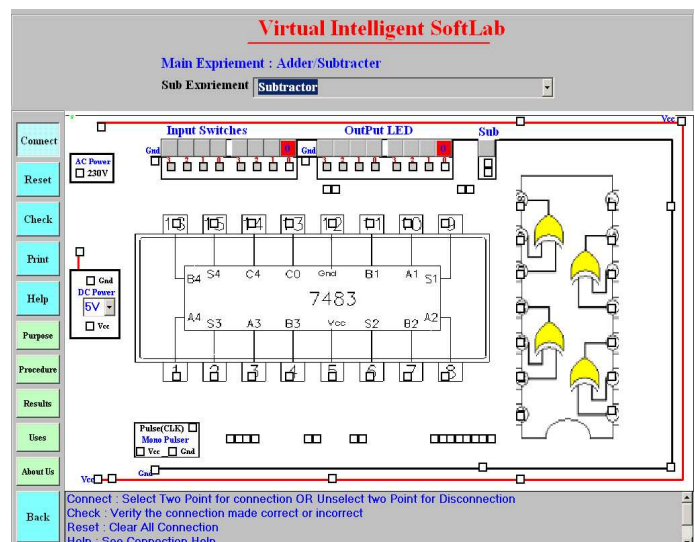

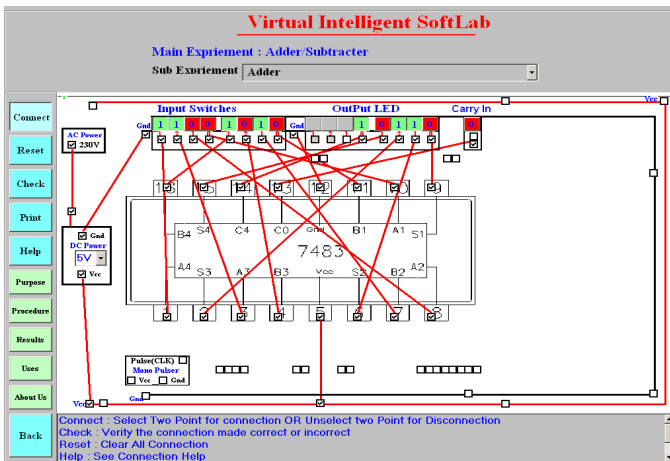Fig. 3. VIS Adder/Subtracter Model before Connection
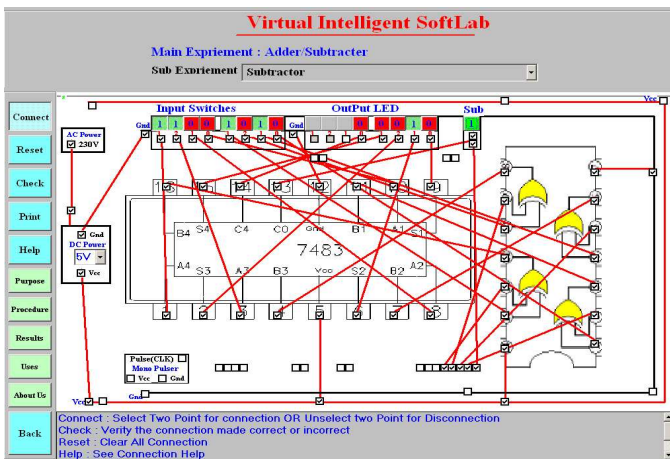
Fig. 4. VIS Model for Full Adder

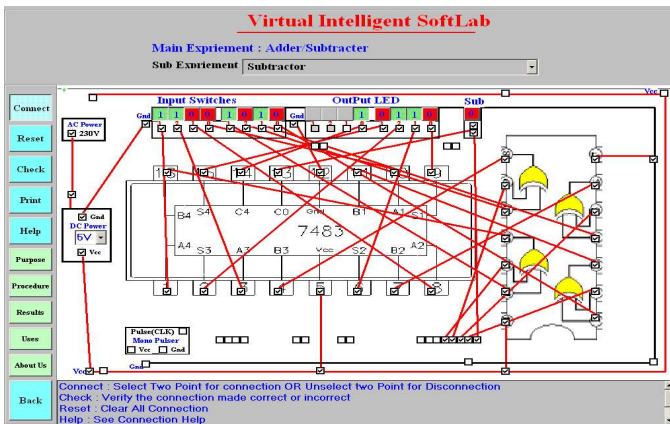Fig. 5. VIS Model for Full Subtracter

Fig. 6. VIS Model for Full Adder

B. Implementations

Once the VIS is ready then we implement the circuits using then following steps. The Circuit Connection Steps are:

- Connect AC socket to DC Converter device
- Connect DC power supply to IC VCC pin
- Connect Ground Socket to IC Ground Pin
- Connect Output IC pin to Output switches
- Connect Input IC pin to Input switches

Experiment Implementation Steps are:

- Made connection by selecting two switches using mouse.
- Click on Check Button to verify the connections.
- Click on Reset Button if the connection is totally WRONG.
- Click on Help Button if any help for connection.
- Click on Menu Button to perform other Experiments

C. Results

Virtual outputs are totally animated with the combination of hardware/software and observed actual outputs virtually.

V. CONCLUSIONS

SoftLab will help Electronics, Computer Science and Engineering department students to perform and practice experiments to improve their understanding of the subject. VIS is designed in such a way that makes more effective and realistic by providing virtual inputs and produce virtual outputs. For the 'touch and feel' part, the students can possibly visit an actual laboratory.

ACKNOWLEDGEMENT

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Bhaskar Y. Kathane completed M.Sc. (Computer Science) and pursuing Ph.D. from R.T.M. Nagpur University, Nagpur. He is Assistant Professor in the Department of Master in Computer Application, VMV College, Nagpur (MS), India. Presently he is working as a research scholar in University Campus, RTM Nagpur University, Nagpur. His research interests include Virtual Intelligent SoftLab (VIS); A Software Solution for Laboratories. He is associate member of IETE (India).

Dr. P.B. Dahikar is a Reader in the Department of Electronics, Kamla Nehru Mahavidyalaya, Nagpur (India). He has more than 20 years of experience in teaching and research. His current area of research includes Electronics Instrumentation and Simulation. He has published more than twenty papers in referred national and international journals. He has also presented more than twenty research articles in national and international conferences. He has written few books related to his research work. He is currently dealing with few projects sponsored by UGC.