Research Note :

Virtual lab for logic gates

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Concepts are hard to imagine without demonstrations or visual effects. The role of virtual laboratories in education is helping students to improve their quality and capability. A logic gate is an elementary building block of a digital circuit. Most logic gates have two inputs and one output. There are several basic logic gates: AND, OR, NOT, NAND, NOR etc. (Jain, 2009; Ram, 2007 and Mano and Ciletti, 2007). The Gates and Circuits module covered in this paper provides following services:

– *Demonstration of basic logic gates*: It shows the functionality of elementary gates by presenting their figure, the number of inputs and outputs as well as their values.

– *Creation of new gates*: It allows the creation of user-defined gates by selecting a figure from a collection of given figures, defining the number of inputs and outputs and finally by identifying the values of these inputs and outputs.

– *Construction of circuits*: It allows the construction of circuits by using existing and user-defined gates showing the way a circuit works.

Virtual laboratory described here tests truth tables of different types of logic gates. The virtual instruments used in testing deliver task's definition to the students. The tool provided here has the ability to find all tasks decisions and to compare it with student decision and their tests.

A gate or logic circuit's truth table must have as many rows as there are possibilities for unique input combinations. For a single-input gate like the inverter, there are only two possibilities, 0 and 1. For a two-input gate, there are four possibilities (00, 01, 10, and 11), and thus, four rows for the corresponding truth table. For a three-input logic device, there are eight possibilities and so on. The input columns are typically written in binary order as shown in Fig. 2, 3 and 4.

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 a 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.

Model:

– It has been constructed the programs in 'VB' such that all the blocks in the architecture can be fully visualized on the screen. This model can demonstrate the activities of logic gates visually. Input based on option button in the form of (1,0) cab be provided to gate and output is observed. For a correct input, the lamp in the output circuit will glow. In an experiment one can provide different input values and observe output.

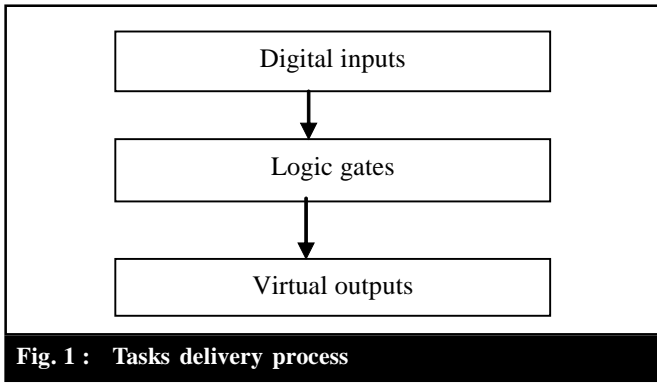The architecture of the system developed for the purpose of virtual lab is shown in Fig. 1.

Fig. 1 : Tasks delivery process

A software programme is written for verification of truth table of AND, OR, NOT and 7-segment display. The input and output are shown in Fig. 2, 3 and 4.

Development and implementations:

For developing the concepts of logic gates based on animation, following basic operations have been considered:

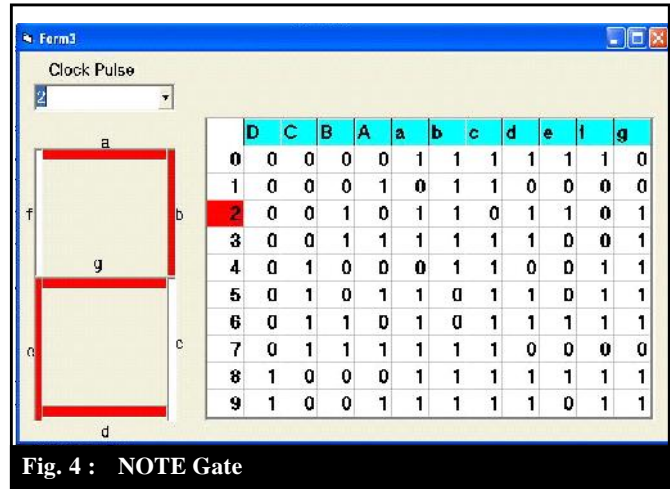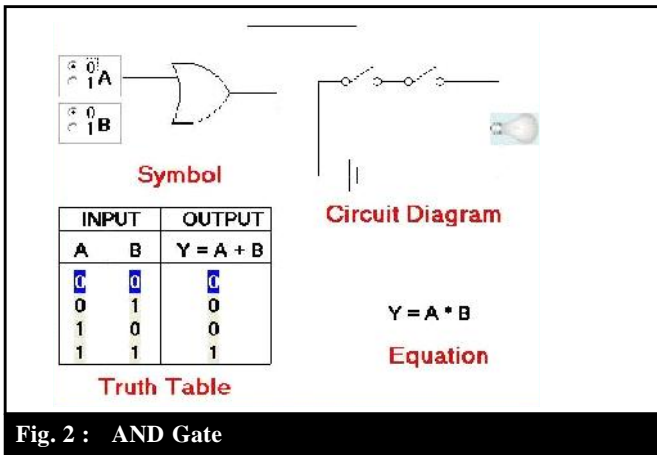Fig. 2 : AND Gate

Fig. 3 : OR Gate

Fig. 4 : NOTE Gate

– AND Gate: working of AND gate with its symbol, circuit diagram and truth table.

– OR Gate: working of OR gate with its symbol, circuit diagram and truth table.

– NOT Gate: working of NOT gate with its symbol, circuit diagram and truth table.

– 7- Segment display: working of 7-Segment display and their numerical digit generation with truth table.

Conclusion:

A test system which is a part of digital logic design virtual laboratory is developed to the stage of tasks delivery. This system will be useful to students for understanding logic gates and may also be used for assessment of students.

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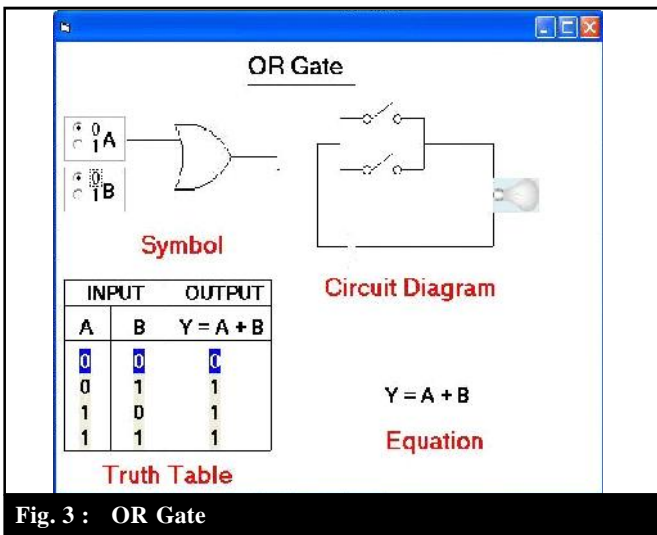**Ram, B. (2007).** Computer Fundamentals, New Age International Pub., 4th Ed.

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