BUILDING ELECTRONICS TUTORIAL

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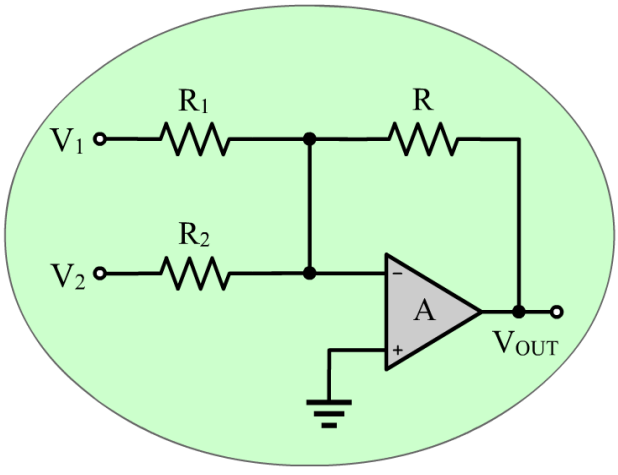
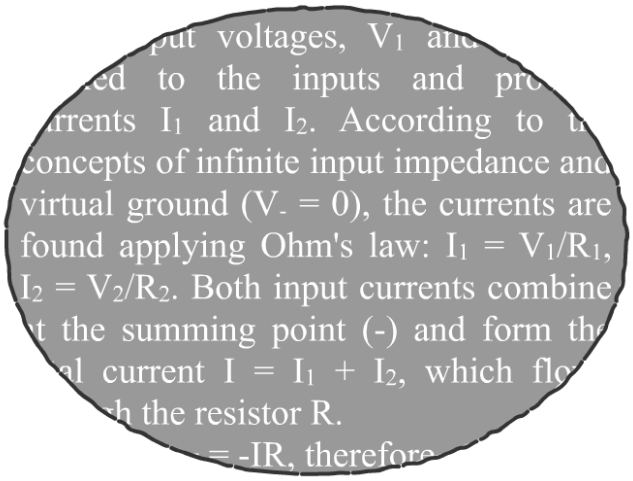
The novel interactive multimedia tutoral described in this paper is designed as an alternative to the classical courses on analog electronics. It is intended for creatively thinking students, teachers and inventors in the area of electronics.

Here, the electronic circuits are not presented as ready-made circuit solutions. Instead, they are built systematically in consecutive units, every one new circuit based on the previous ones. First, the most elementary passive building blocks are derived from basic electric circuits. Then, these "bricks" are used to build more complicated compound passive circuits. Further, adding active elements in accordance with suitable basic ideas, a lot of transistor circuits are built. Finally, applying the powerful negative feedback principle in all its variety, these circuits are metamorphosed into almost ideal op-amp ones. Doing that, students will be able to convert any even completely unknown imperfect passive circuit into an ideal op-amp one.

1. INTRODUCTION.

In the classic electronics courses, the electronic circuits are presented in their complete, final and perfect form (see for example the classic op-amp inverting summator – fig. 1a). Only, the formal methods do not explain circuits. The mathematical models they use cannot reveal the basic ideas circuits are grounded on: these models hide structure, causality and structure-function relations. Formal methods may even lead us to absurdity analyzing something, not really knowing what it is like [fig. 1b].





a) Fig. 1 b)

2. PROBLEM. Every, even the most elementary electronic circuit, is based on clear and simple basic concepts. In order to understand circuits, we have first to reveal the basic concepts behind them. For this purpose, we may begin by breaking circuits up into their building blocks and, about each block, we ask ourself questions such as: "What is it really like? What does it do? What is its role in this circuit? Where else have we met something of the kind?
In this way, moving back slowly, we will restore step by step the evolution of electronic circuits. Next, we teachers may present circuits in their logical succession: building and inventing rather than analyzing them as ready-made circuit solutions.

3. TUTORIAL. In the tutorial proposed, the electronic circuits are not presented as ready-made circuit solutions to be analyzed in their complete, final and perfect form. Instead, they are built systematically in consecutive units, every one new circuit based on the previous ones. First, the most elementary passive building blocks are derived from basic electric circuits. Then, these "bricks" are used to build more complicated compound passive circuits. Further, adding active elements in accordance with suitable basic ideas, a lot of transistor circuits are built. Finally, applying the powerful negative feedback principle in all its variety, these circuits are metamorphosed into almost ideal op-amp ones [1].

3.1. Structure. The tutorial is implemented in consecutive units using the same concrete building "scenario" (see for example Unit 1 – fig. 2):

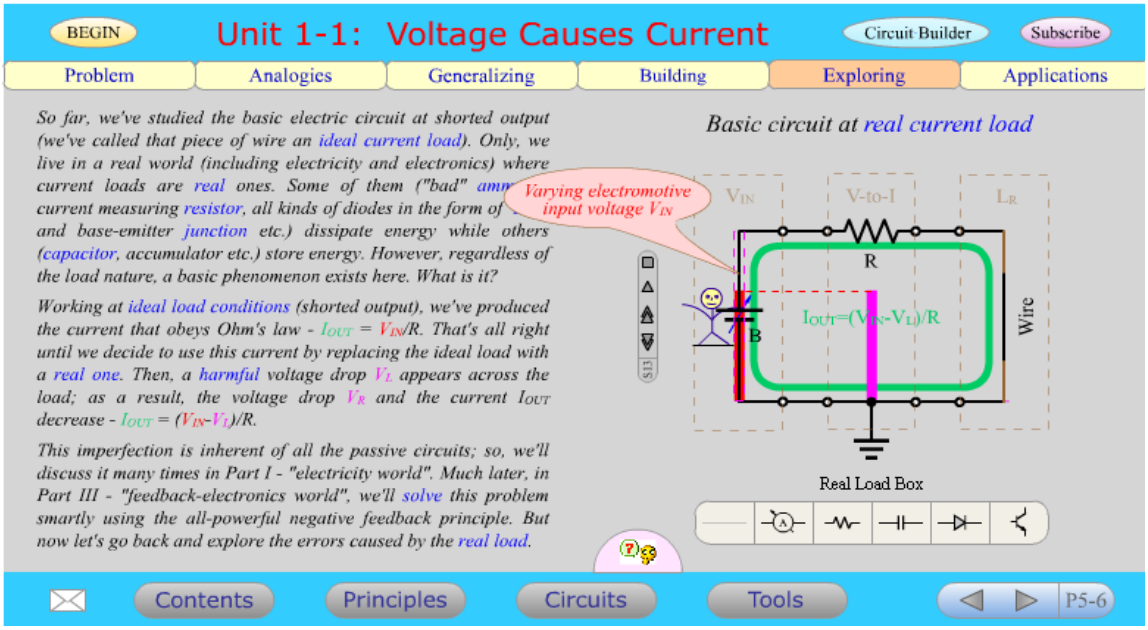


Fig. 2

1. Posing the problem to be solved.
2. Looking for analogies where a useful phenomenon appears.
3. Generalizing the analogies into a basic principle and a functional block diagram.
4. Implementing the results into a new electrical building block.5. Exploring the circuit operation by means of multimedia interactive tools.
6. Applying the abstract building block in more concrete circuit applications.

The basic ideas, circuit building blocks and tools created in the tutorial are gathered into a *principle*, *circuit* and *tools collections* with the purpose of their future use.

3.2. Implementation. The tutorial is implemented as Macromedia Flash movies. Interactive action script controlled animations, hyperlinks, hidden explanation buttons and sounds are associated to the circuits operation. Also, a lot of innovative interactive tools (potential bars and diagrams, current loops, superimposed I-V curves etc.) are used to visualize and sound the invisible electrical attributes of the circuits. For example, a passive voltage-to-current converter is shown on the fig. 2.

4. CONCLUSION.

The tutorial proposed in this paper is based on human imagination rather than formal resoning. Here electronic circuits are build step-by-step using more elementary building blocks connected in the conformity with basic ideas derived from real life.

5. REFERENCES.

[1] Mechkov C., *Heuristic methods for converting passive analogue devices into negative feedback active circuits*, Proceedings of The Sixth Int. Conference ELECTRONICS'97, 1997.