Understanding the electric circuits

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Our study is developed in the framework of the Comenius "Hand's on Science" Project.

The major goal of the enterprise is to study the electric circuit's elements like resistors, batteries, bulbs and semiconductor diodes in order to increase the understanding of their behavior, to explain what happens in an electric circuit when the switch is turning on, because we cannot "see" what is happening inside the circuit.

First, the students had to simulate the simple electric circuit using LabVIEW and to measure the voltage and the amperage. A simple DC circuit with one resistor, a supply a voltmeter and an ammeter is shown in the fig. 1. The students learn to measure the voltage and the current in virtual way (it's more safely).
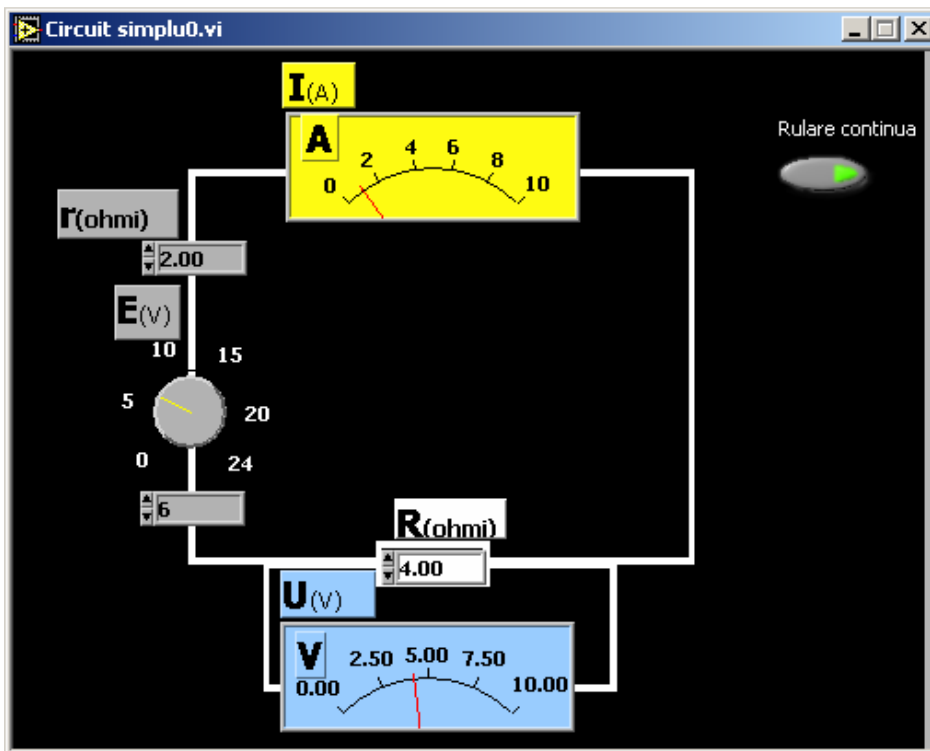

fig.1

After this the students introduced another resistor in the circuit. (fig. 2, fig. 3) They can verify Kirchhoff's laws now. The developing of these circuits supposes that they know the equations between voltages and currents in the circuits.
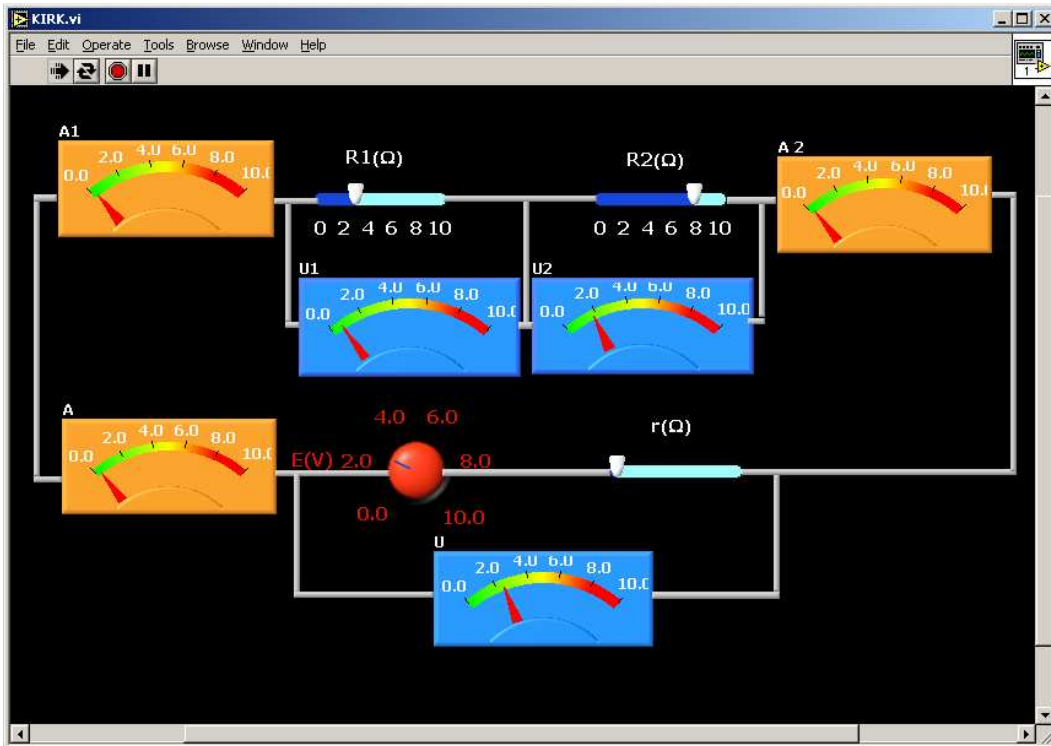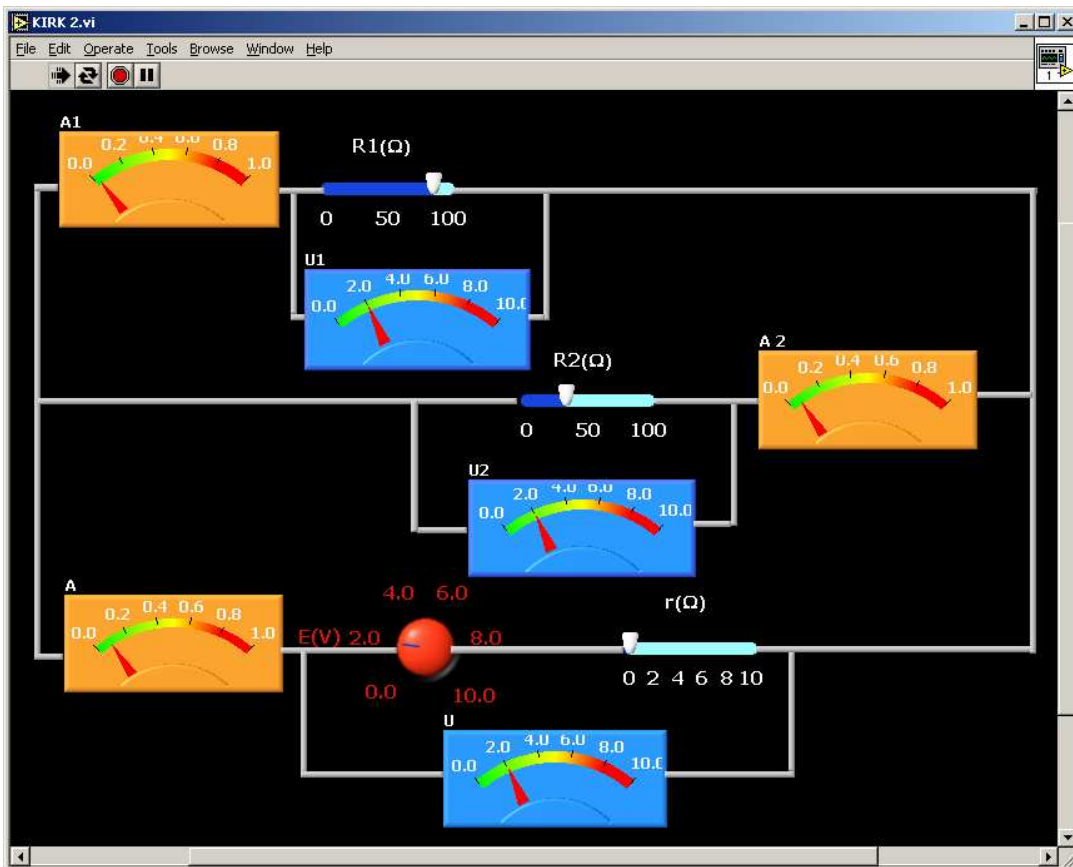
fig.2

fig.3

After that the students have to imagine the way for raising the current dependence on voltage for the resistor (characteristic I-U curves) using the virtual instrument shown in the fig. 4.
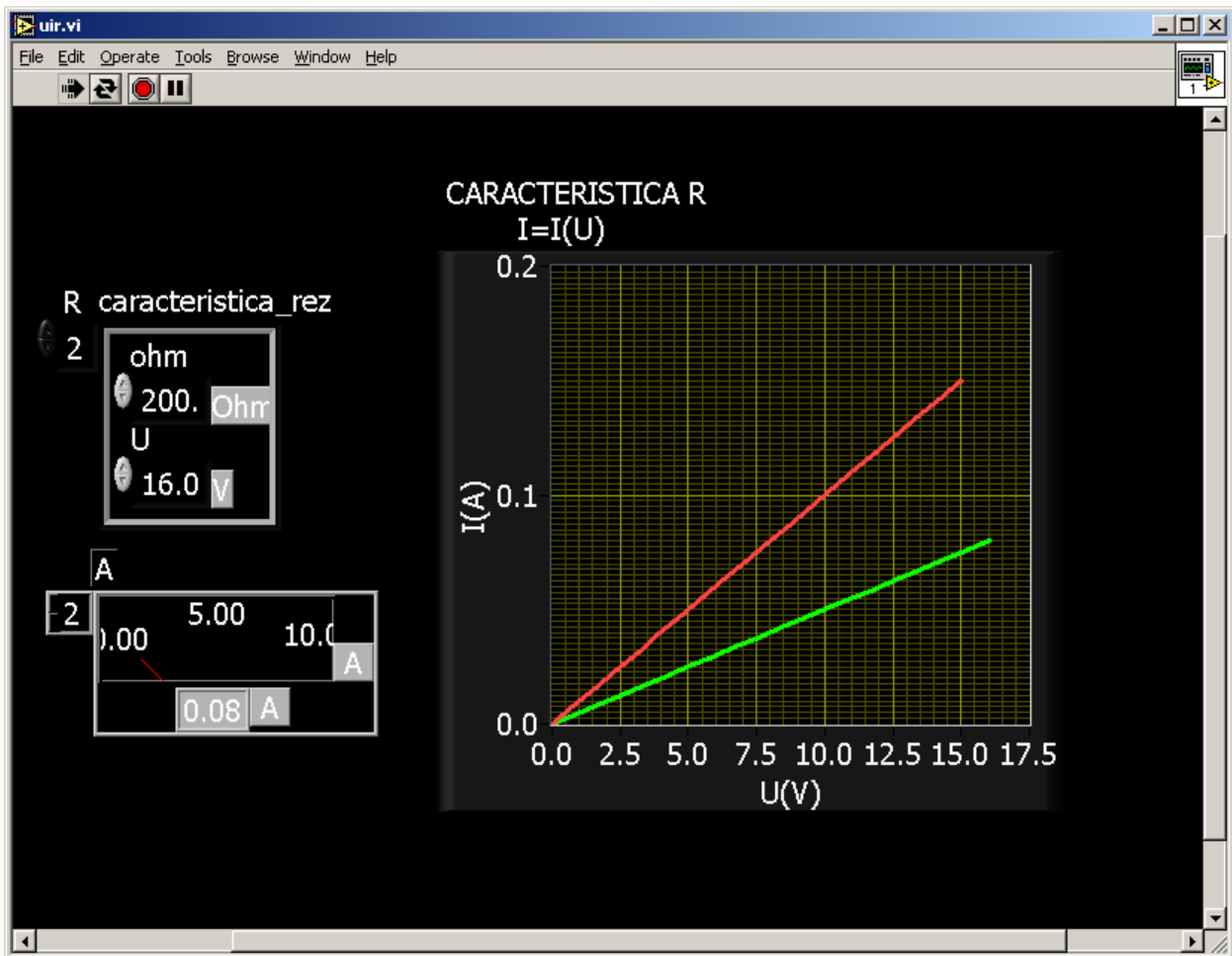

fig.4

When the graph is ready they have to discover the signification of the slope of the straight line which is I=I(U).

Our second goal was the registration of the voltage and the current dependence on time (for the given element) using a data acquisition board NIDAQ-6013. Finally the two dependencies generated a new one: the characteristic I-U curve for each element. The DAQ-software was developed with LabVIEW. When the data acquisition finished the students had to explain the obtained results.

The experimental device used for the study of the resistor characteristic I-U is shown in the fig. 5. The additional resistor is used for
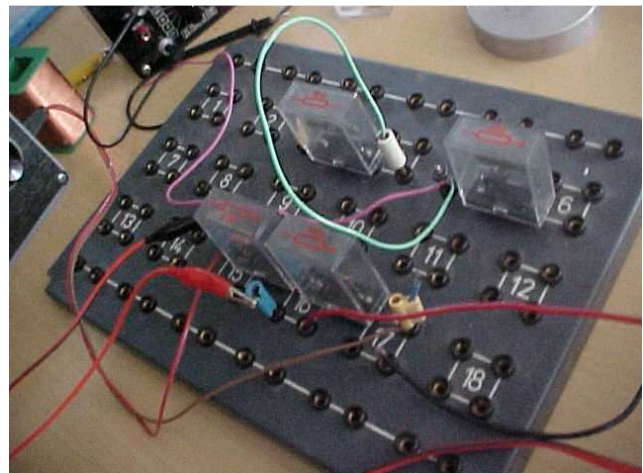

fig.5

measuring the current, by dividing his voltage to the value of it's resistance. The data acquisition looks like the fig. 6. The average value indicated for the resistance is 106 Ω (the value written on it is 100 Ω).
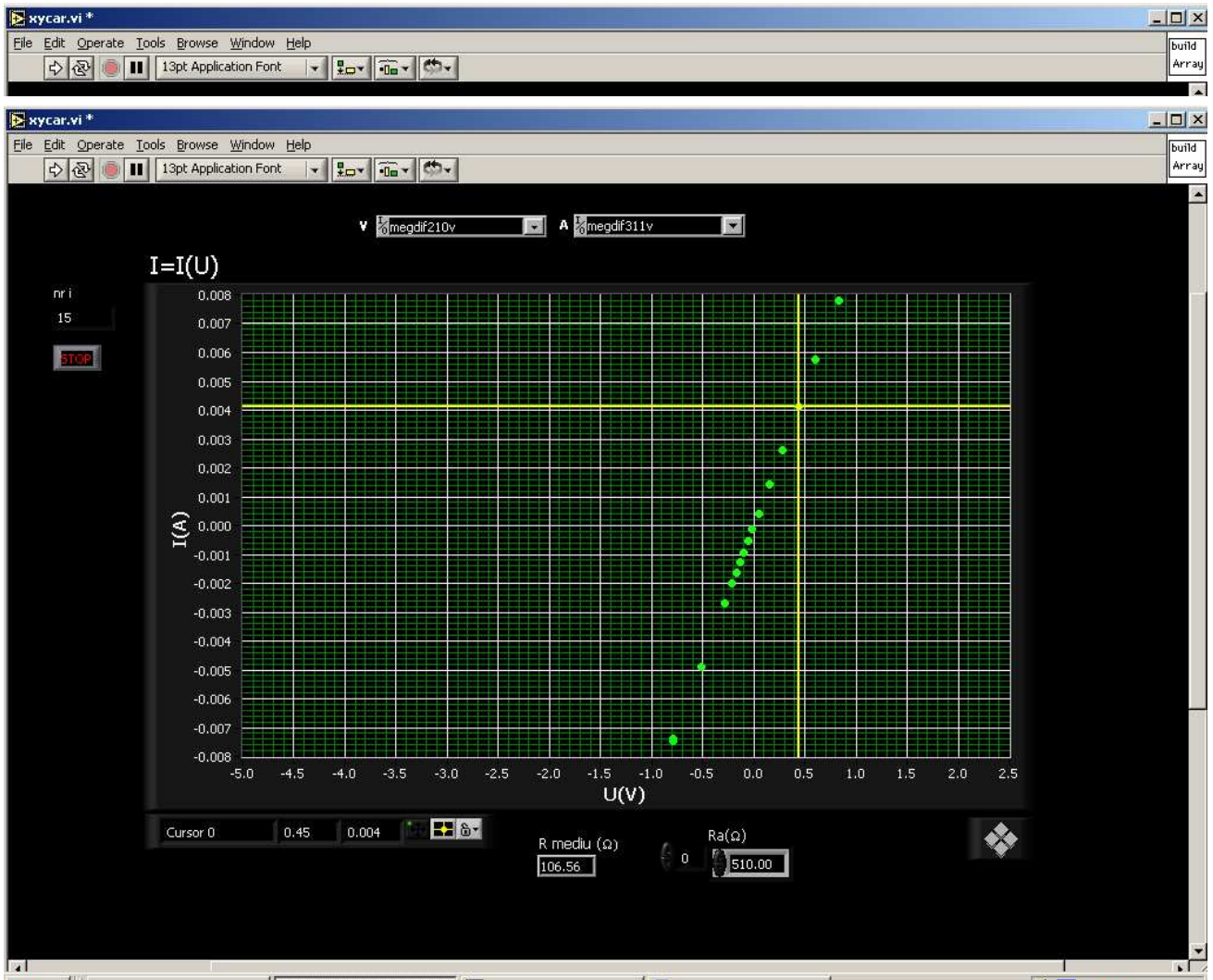

fig.6

The experimental device used for the study of the bulb characteristic I-U is shown in the fig. 6. An additional resistor is used for measuring the current, by dividing his voltage to the value of it's resistance. The data acquisition looks like the fig. 7. The "cold" value indicated for the resistance of the bulb is 3 Ω and the "warm" value it is 23 Ω as you can observe in the fig. 8.
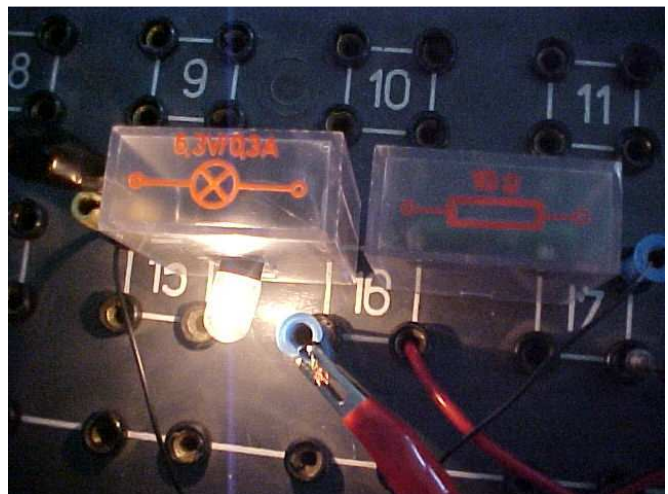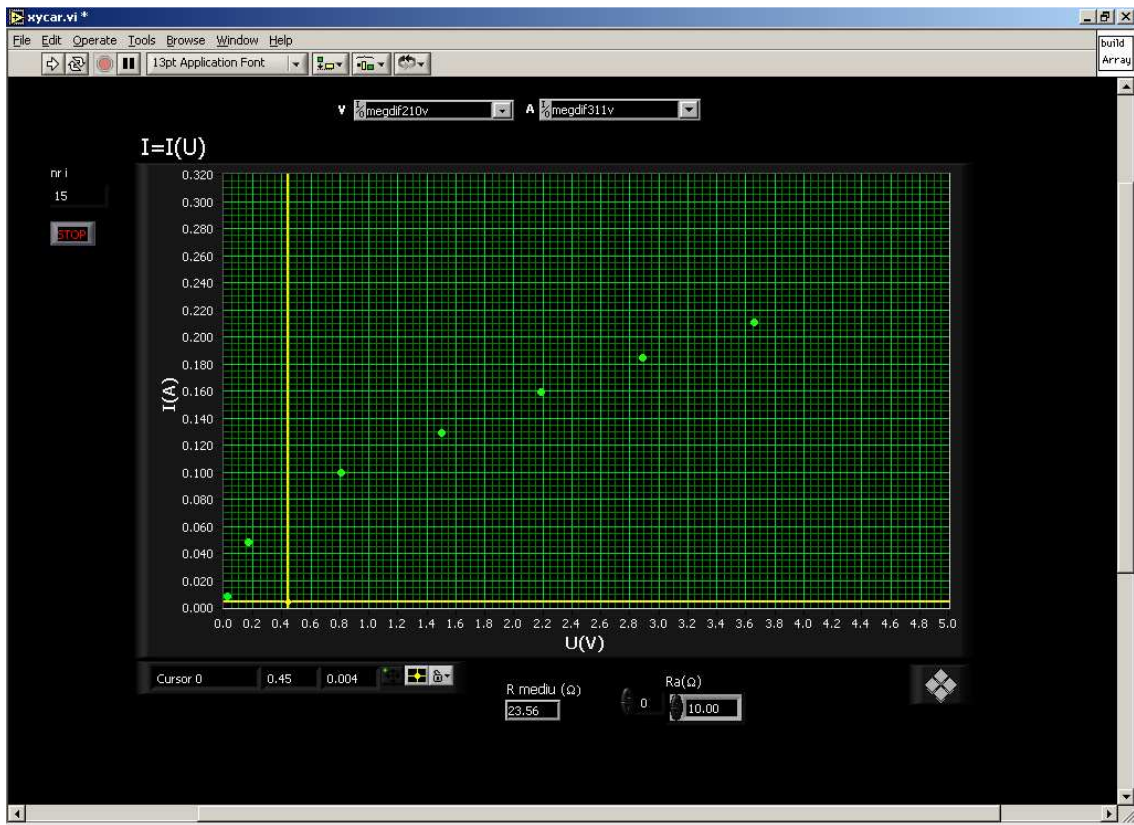

fig.7

fig.8

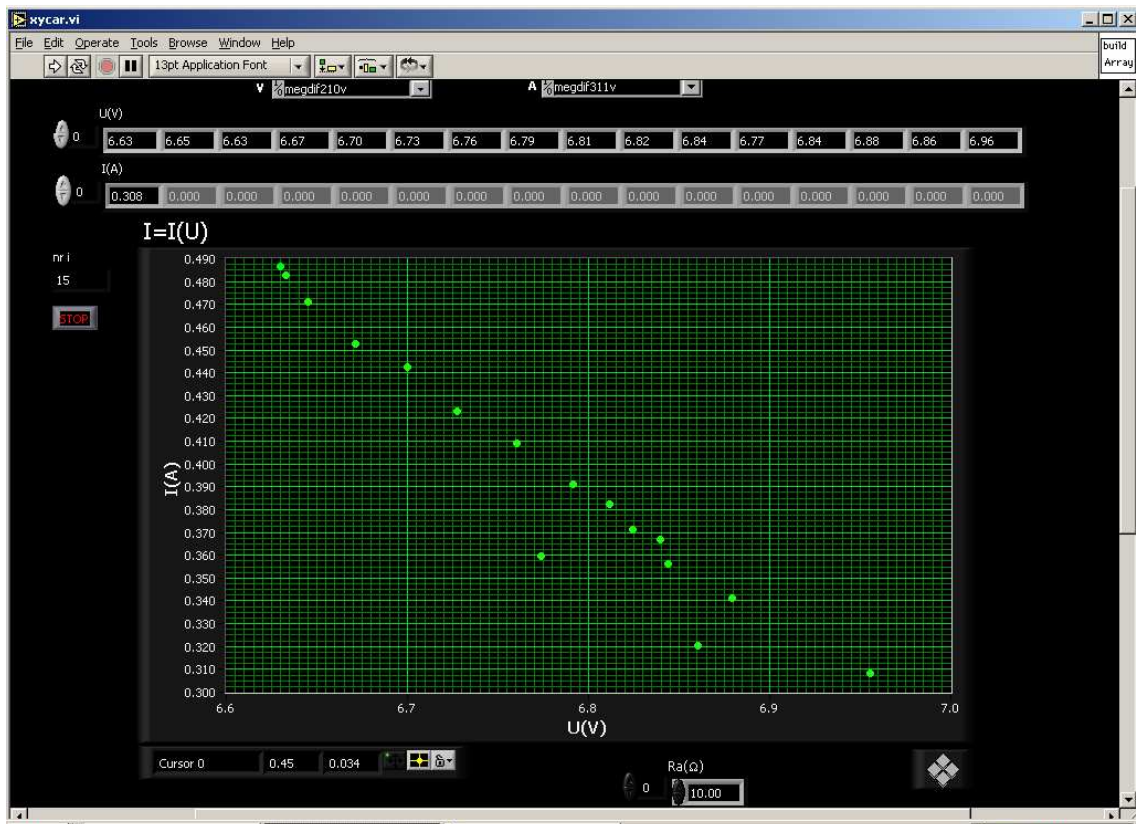The experimental device used for the study of the supply characteristic I-U is shown contain an

fig. 9

adjustable resistor and an additional resistor (10 Ω),for measuring the current, by dividing his voltage to the value of it's resistance. The data acquisition looks like the fig. 9. The students have to calculate the value of the voltage of the supply and it's internal resistance.

The experimental device used for the diode (LED) characteristic I-U is shown in the fig. 10. An additional resistor is used for measuring the current, by dividing his voltage to the value of it's resistance. The data acquisition looks like the fig. 11.
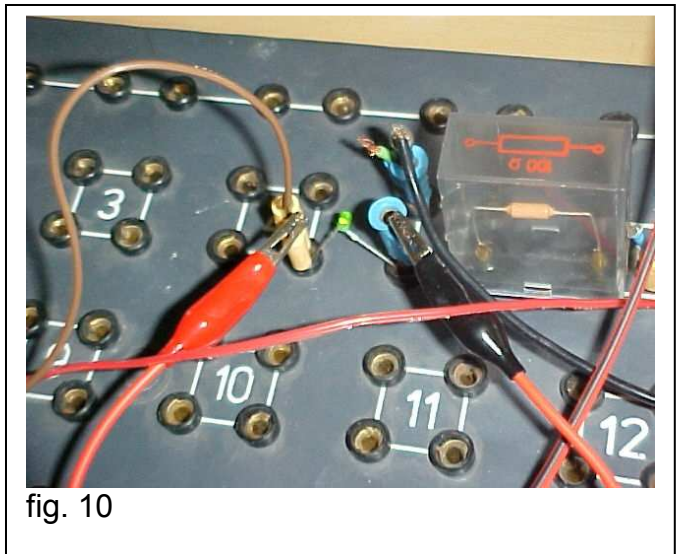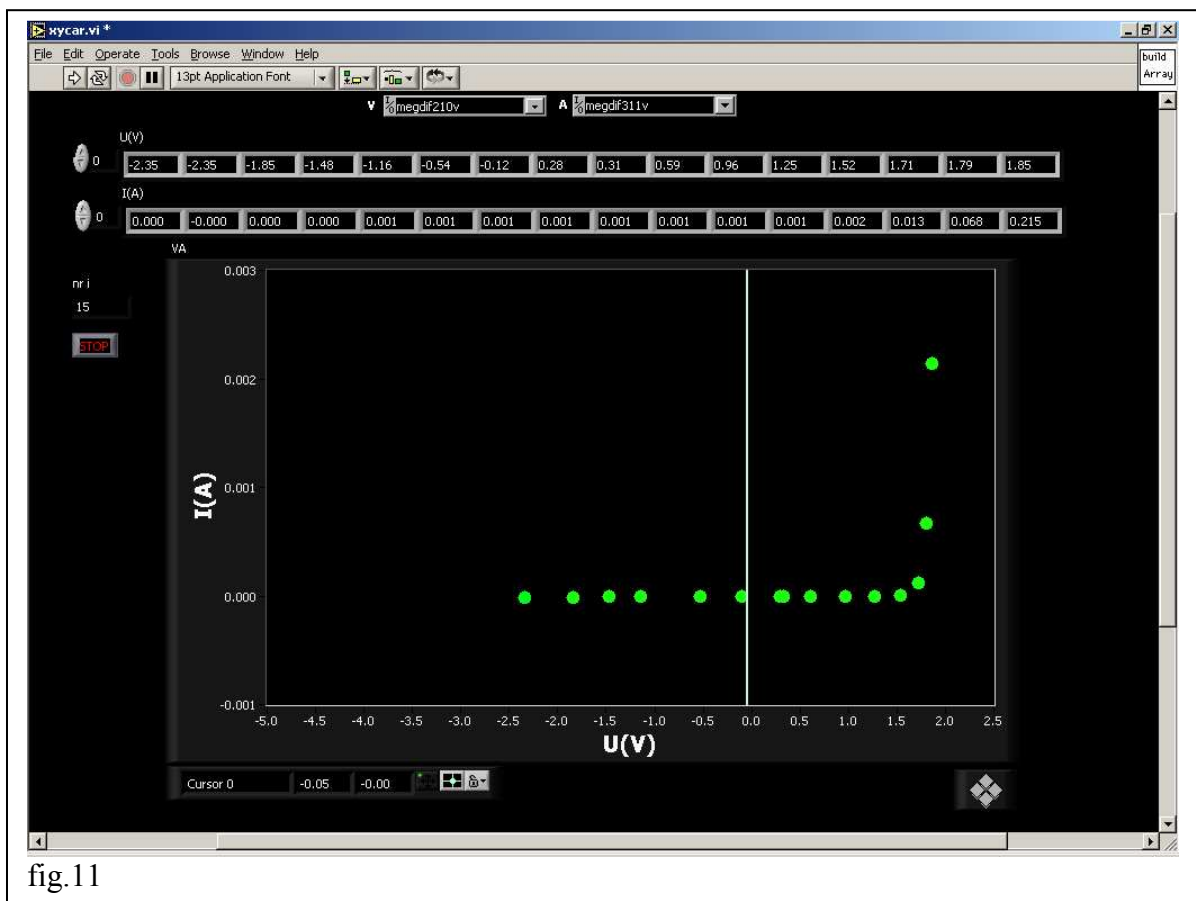

fig. 10

fig.11

Keywords: LabVIEW, DAQ-data acquisition, DAQ-software, VI-virtual instrument, resistor, bulb, diode, supply.