AUTOMATIC LABORATORY CELLS CYCLING AND MEASURING SYSTEM

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Abstract

An automated data capture system comprising an electronic measuring board and charge and discharge power source connected to a computer was developed for laboratory cycling of battery cells. Development, checkout and the improvement of the measuring software is showed in this paper.
Newly designed and developed measuring apparatus leads to establishment of modern, precise, prompt, reliable, user-friendly and graphically-object-oriented measuring program which removes deficiencies of the contemporary measuring workplace and which greatly expands possibilities of existing measurements. Measuring program was developed under MS-Windows 98 SE platform by the usage of the program VEE Pro 6.0. Data will be automatically saved to tables and directly presented with help of charts in the spreadsheet of program MS Excel.

Introduction

New measuring system will replace the contemporary measuring apparatus which started being developed on our workplace 10 years ago and was using operating system MS-DOS and programming software TurboPascal 5.0. This equipment enabled to execute the automatic measurement of the contact resistance and the resistance of active mass and further automatic cycling of monitored cells together with the cell voltage and cell current data recording. However the evaluation part was problematic, because of the data was necessary to computerize on another computer and there was no possibility to watch the progression in the graphic form during a measurement. On the top of that the multimeter and computer failed as well. All of this was brought about the deceleration of evaluation and it was not possible to flexible respond to the problems generated in the course of the whole experiment process. Used measuring software was not possible to use in combination with new high-speed computers. This complicated exchanges of defective and serving out parts of the measuring PC.

Measuring Apparatus

The measuring system design for automatic laboratory cells cycling can be seen on Fig. 1. The apparatus centre is a computer which is connected with the GPIB cable to the peripheries with help of the GPIB card placed in PCI slot. The measuring software controls the measuring switch-board and the DC power source. The equipment for measurement of the internal resistance is connected both to the laboratory cell and to the multiplexer. Voltage proportional to the cell internal resistance and the total cell voltage are brought to the multiplexer. Switching of the discharging / standing / charging of laboratory cells runs in the switch-board. The current is directly read from the power source.

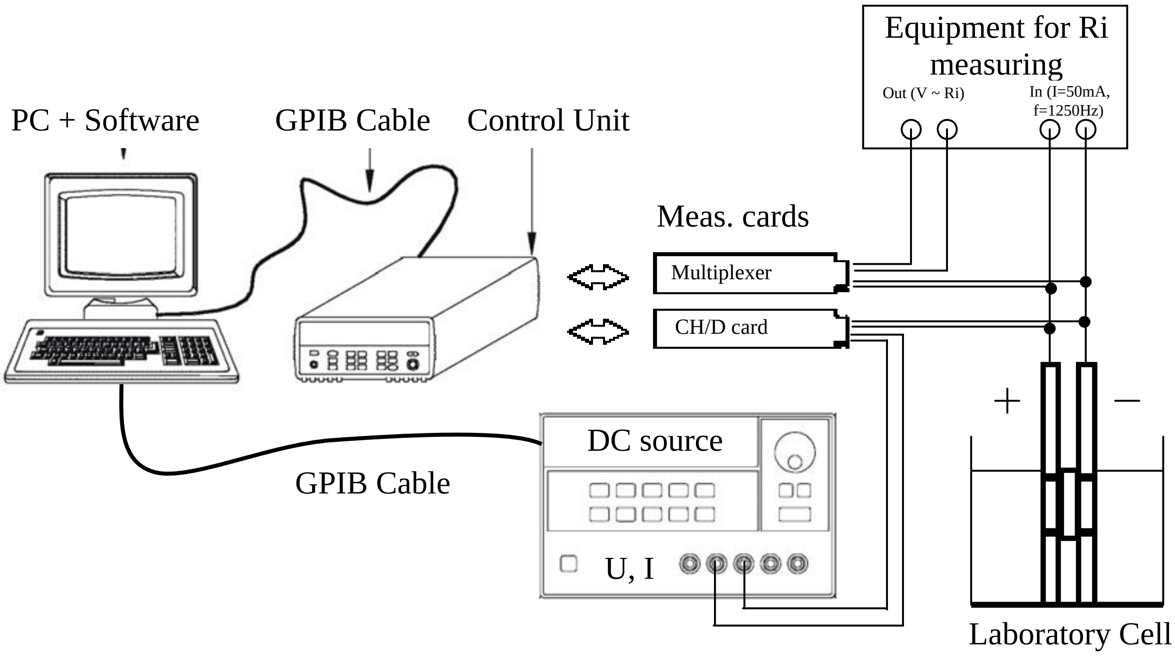

Fig. 1 *The measuring apparatus for the automatic laboratory cells cycling, the internal resistance measuring and the other important parameters of laboratory cells.*

Software

Measuring software VEE Pro 6.0 is based on the object programming - the programmer defines the input and output data flow of the individual template program modules. The basic instructions which control the peripheral equipment are inserted in the various control modules. The final software is formed by the efficient connection of these functional modules.

There is possible to see schematic diagram of measuring program which is assembled from the few basic modules on the Fig. 2. After pushing the button "Start" it comes to the data loading (date, number of cycle, cell capacity, etc.) from the file (the module "Read data from file"). Charging and discharging of experimental cells (module "Charge" and "Discharge") is executed in never ending loop that can be interrupted both by the operator (the button ‘Switch off’) and the any peripherals equipment error - measuring card, source, outage electric flow. Measured magnitudes (Timer, Counter, Voltage, Current, Internal Resistance) are measured after the given intervals and simultaneously recorded to the MS Excel tables (the module ‘Writing data to Excel’) and instantly graphically displayed - see Fig 3.

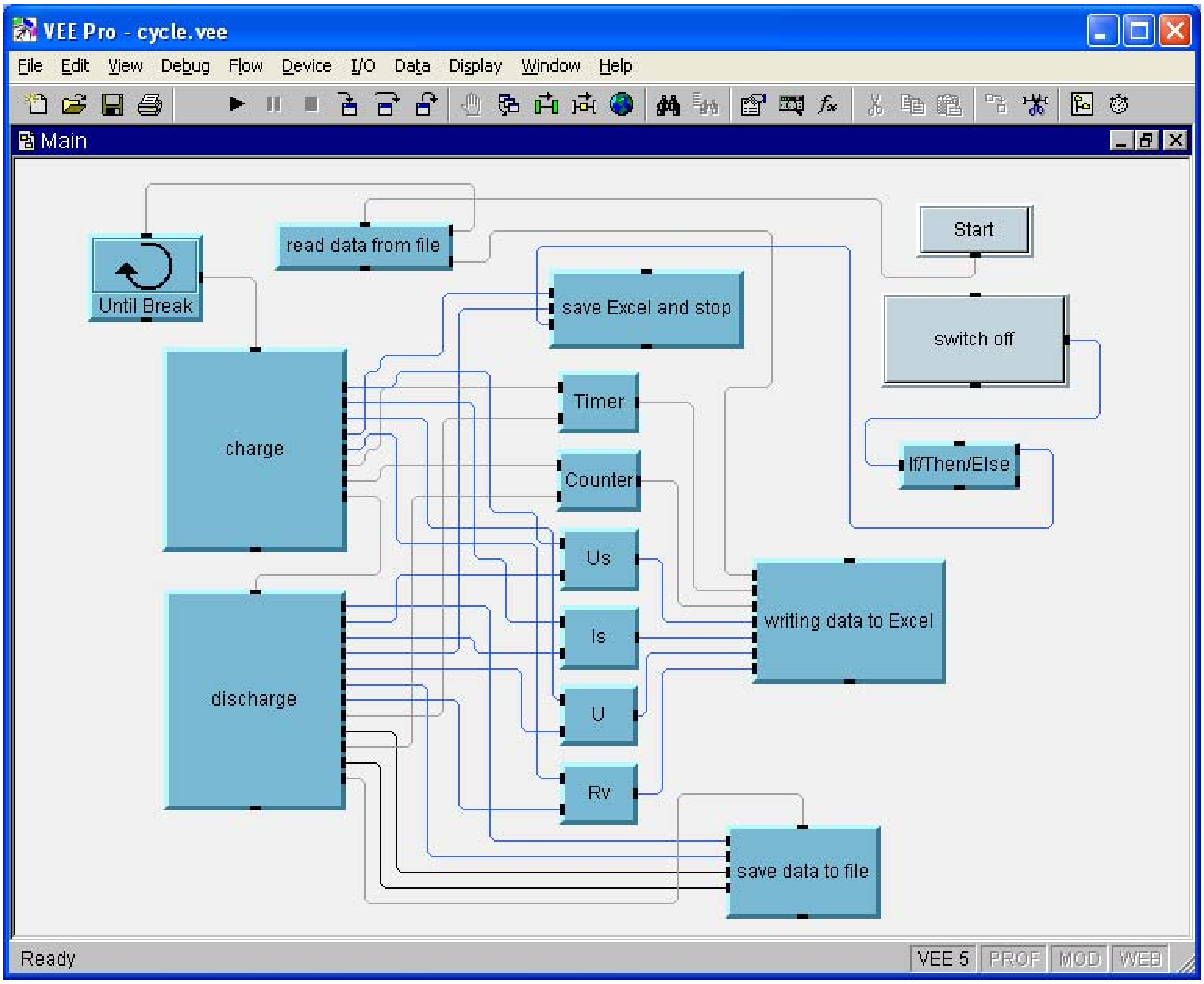

***Fig. 2** Schematic diagram of measuring program*

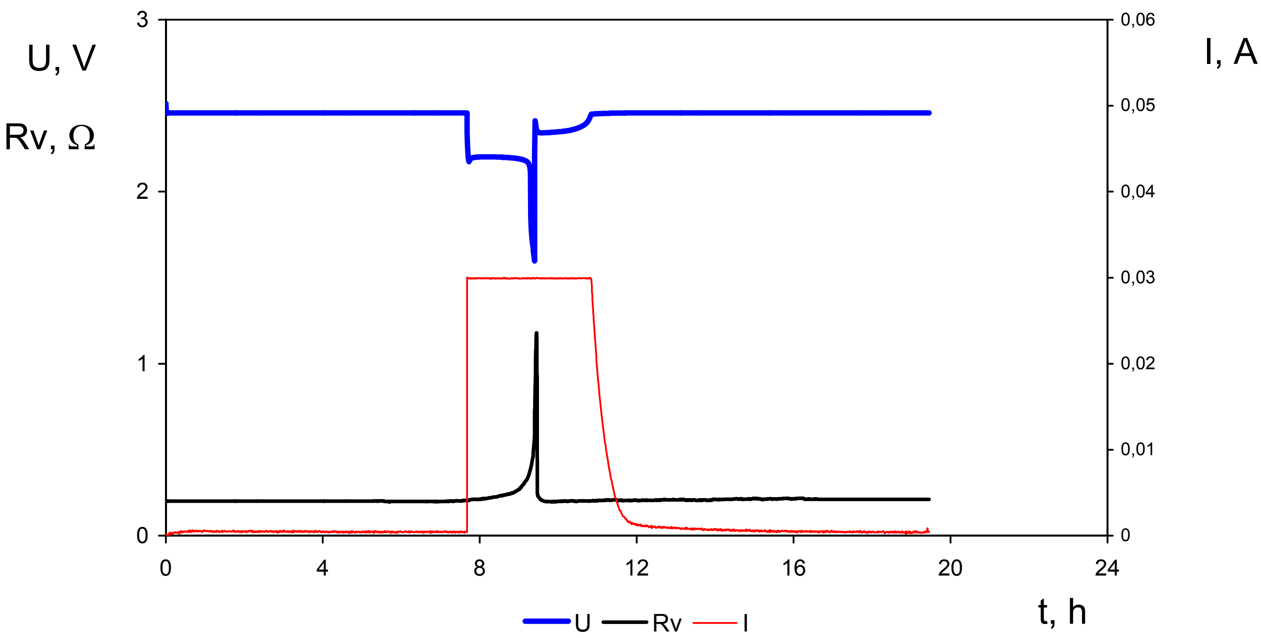

***Fig. 3** Graphical dependencies of measured values*

At the end of each measuring cycle the important data (date, number of cycle, cell capacity, etc.) is saved to the file (the module 'Save data to file').
There is possible to see the diagram of the module 'charge' in detail on the Fig. 4. The input values of variables can be set in the module – the charging current (the module 'current'), the voltage limitation (the module 'voltage limit'), the duration of measuring cycle (the module 'Delay') and the time of the end of charge (the module 'If/Then/Else'). At the beginning the module 'charge' program switches off the discharge contacts (the module 'Discharge off'), sets the power source in agreement with input values of variables (the module 'Source adjust') and at last switches on the charging contacts (the module 'Charge on'). After that the important parameters of experimental cells both on the source – voltage, current (the module 'source measurement') and on the multiplexer card – voltage, internal resistance (the module 'Module measurement') are measured after the given intervals.

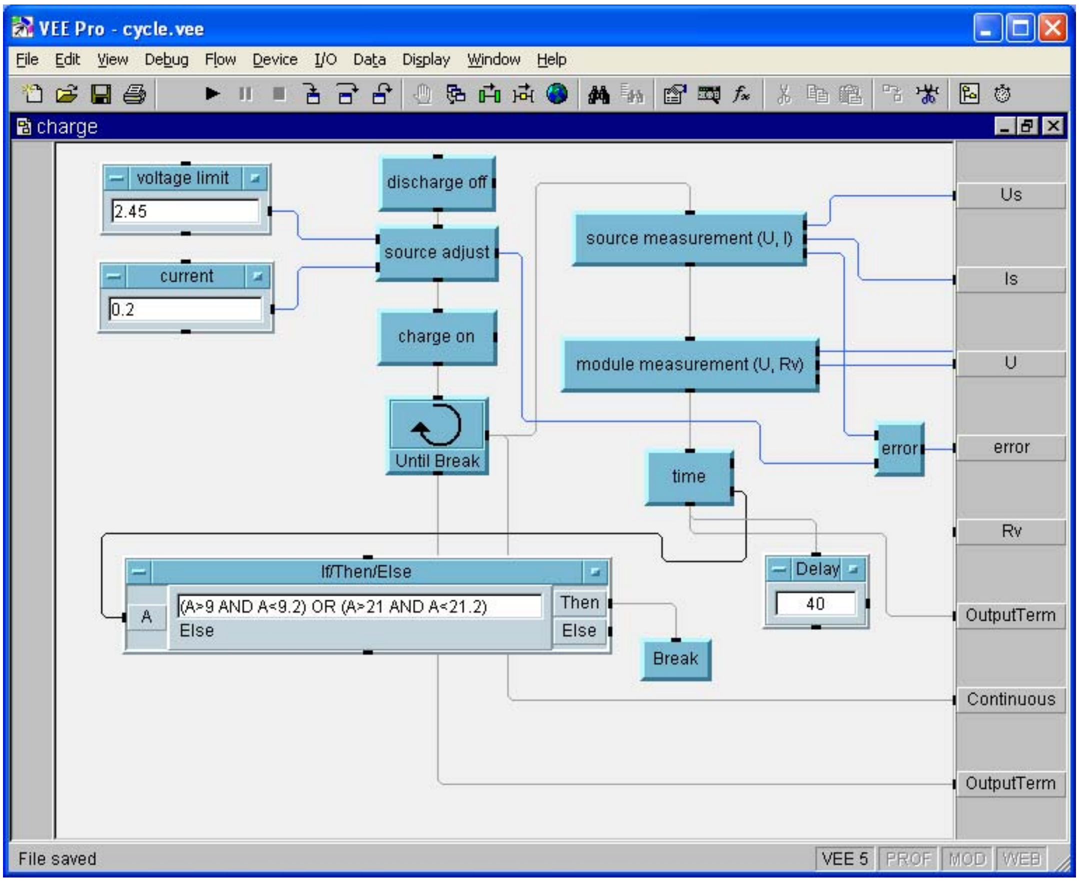

Fig. 4 *Module 'charge'*

There is possible to see the diagram of the module 'discharge' in detail on the Fig. 5. The input values of variables can be set in this module - the discharging current (the module 'Current'), the duration of measuring cycle (the module 'Delay') and the voltage on the end of discharging (the module 'If/Then/Else'). At the beginning the module 'discharge' program switches off the charge contacts (the module 'charge off'), sets the power source in agreement with input values of variables (the module 'Source adjust') and at last switches on the discharging contacts (the module 'Discharge on'). After that the important parameters of experimental cells both on the source – voltage, current (the module 'source measurement') and on the multiplexer card – voltage, internal resistance (the module 'Module measurement') are measured after the given intervals.

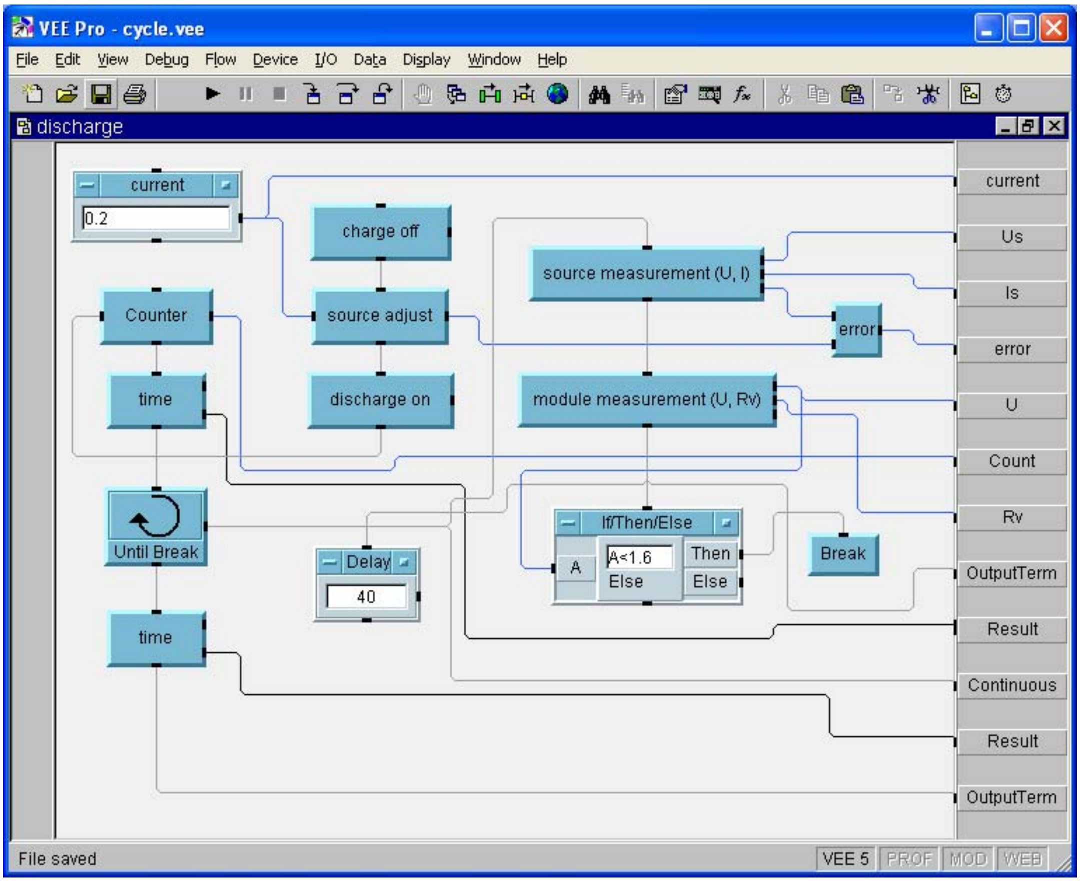

Fig. 5 Module 'discharge'

There is possible to see the example of command sequence for the voltage and the internal resistance measurement of experimental laboratory cell in the multiplexer card (the module 'module measurement') on the Fig. 6.

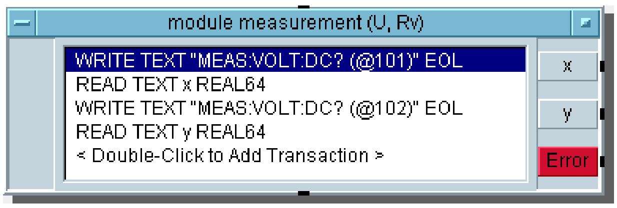

Fig. 6 Module measurement

On the first line there is the command which sends the instruction for the data reading on the port @101 (the cell voltage is connected to the port @101). Subsequently the value of voltage is read and written to the variable x. In a similar way there is made the data reading on port @102 which is reserved for internal resistance measurement. The value of internal resistance is written to the variable y.

Conclusion

The automatic measuring system allows the large-scale long-term experiments making without presence of operator. This is made possible by the automatic start of runtime version of measuring software in MS Windows platform even after the computer reboot. User friendly graphic environment allows monitoring the measured data in the course of experiment. It makes possible to operator to respond on critical situations, which could happen in time. Thank to graphic-oriented object programming there is possible to modify the program according to needs and up-to date requirements.

Acknowledgement

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References

1. P. Křivák: Study of the impact of compression upon the properties of positive electrodes of the lead-acid accumulator, thesis, Brno 2001.