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COMPUTER SUPPORTED LABORATORY REPORTS OF EXPERIMENTAL WORK

Reports on experimental work should be based on a well-documented laboratory report. With the laboratory report we mean the logbook, kept during the experiments. Making such a laboratory report is an important part of the practical courses at our Electrical Engineering faculty in Twente. Nowadays our students write their report on paper. We consider the option to write it directly on the computer so that it can be integrated with managing the measurement results. Doing this however will pose severe requirements to the user friendliness of the software environment. In this paper the idea of an integrated computer environment for doing experimental work is discussed, together with some problems.

Keywords: laboratory report, computer supported, measurement report.

1. INTRODUCTION

Traditionally, during practical work the (measurement) engineer will keep a lab report in which all relevant details of the work are written down on paper. These details will include a description of the set-up, the underlying theory, simulated and experimental data, an analysis of the results and finally conclusions. Nowadays, almost all practical work is supported heavily by the computer: The design of equipment is carried out on the computer, measurement data are stored and processed on the computer and the final report is written on the computer. Because of this, the lab report, still being written on paper, has obtained a somewhat isolated position. Most importantly, it cannot contain all relevant details anymore, as the original practical data is too much to be written down in the report. Because of this, a tendency may grow of experimental work being documented poorly.

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In this paper, a project is described to investigate the possibility of an integrated computer environment for experimental work. Using this environment, one should be able to store experimental data in a clearly organised way so that the user may view any data at any time. Also facilities for writing a lab report should be present.

As in former times, the lab report will have to contain all relevant details of the work. The original experimental data may be included directly, but they may also be referenced. They must however be present in the integrated environment so that they are available for consultation.

The remainder of this paper will be as follows: In section 2 requirements to the software will be gathered. In section 3 a sketch is given of our new environment. In section 4 the planning of the project is explained. Conclusions are given in section 5.

2. REQUIREMENTS TO A SOFTWARE ENVIRONMENT

2.2. USER FRIENDLYNESS

In the first place, users (among them students) should be stimulated to document their practical work well. Using the computer for this should cost the user no more time than a hand written report would have taken. If possible it should save time to the user. This requirement is by no means an easy one, as a lab report will contain elements like equations, graphs, tables etc. and software packages for making these, often work clumsy with many mouse actions.

ORGANISATION AND COMMUNICATION

An experimental set-up nowadays may contain many elements, all connected to a computer system:

- Dedicated hardware and software for measurement and control purposes,
- Software for simulation and data processing,
- Word-processing software.

It is therefore easy to lose the overview over the set-up and the experimental data. Thus, it is important to keep an effective bookkeeping of them:

- The original measurement data should be kept in store explicitly and well separated from processed data. They must be documented: The date of measurement and relevant system parameters should be stored with the data.
- The validity of the data should be checked. Have the measurement data been changed since last data processing, which produced processed and presented data (graphs)?

- It is not allowed to change the results of an “official” experiment. So it may be necessary to fix experimental data at a certain point of time and to provide them with some sort of “stamp”. This is certainly important if the results are used afterwards to prove certain facts formally (like before the court), to prove originality and to protect intellectual property.

2.3. IMPLEMENTATION

As software developments go fast, it is not an option to develop dedicated software for this project. Existing software will be used as much as possible. The main focus of the project is therefore to integrate existing software components. This will happen in a flexible way so that new software components can be added easily in the future.

3. A SKETCH OF AN ENVIRONMENT FOR EXPERIMENTAL WORK

In this section a computer environment for doing experimental work is described. At the moment it still does not exist. We concentrate on our wishes, that is how we would like it to be and we concentrate on how it should look to the user

3.1. SOFTWARE ENVIRONMENT

At first we present a simple model of the experimental environment, as the user will perceive it.

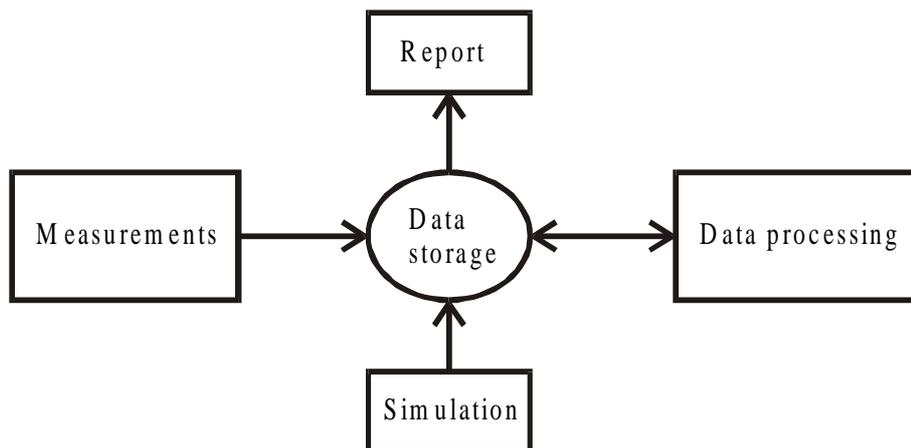


Fig. 1. Sketch of an experimental environment

The user acquires measurement data, mostly using a computer program like Labview, but possibly by hand. Also for comparison, data may be obtained from simulation programs. The data is stored at a central place, where it is available for processing, using a variety of programs. The report should be written directly after the experiment, describing the work, the measurement conditions, the equipment used and presenting the data.

Note that in this scheme the simulation block plays an equivalent role, compared to the measurements. Thus, one may start with simulations and do the measurements later.

3.2. THE GRAPHICAL USER INTERFACE

Figure 2 presents a sketch of a possible user interface. It is quite speculative and should only be regarded as indicating a direction for the future development. The left pane shows a tree containing all data. At the right side two panes are shown: the upper pane shows a set of original measurement data. The lower one contains a written report with a graph of the measurement data. To conclude, the upper pane of the window shows the available software tools for measurement acquisition and processing.

The following remarks are made:

- The tree in the left pane should give the user a clear overview of all data created during the experiment: raw measurements, processed data, simulated data and the report. Additionally, dependency relations between the data sets may be indicated. Also a “make-tool” may be added for updating processed data.
- Up to the user’s choice, one or more panes at the right side of the screen contain views of selected data sets and possibly of the report. In the example of figure 2, the data from Set 1 is shown in the upper pane. The lab report in the lower pane contains a descriptive text, together with a graph of the data from Set 1.
- If software tools for equations, sketches, schemes etc. appear to work too slowly, the use of a tablet may be considered for creating drawings by hand.

Using this environment, the experiment can be carried out following a number of steps. First a measurement program produces datasets 1 and 2. Then Set 1 is processed by a “graphical program”, to produce a graph of the measurement data. Finally a lab report is written in which the graph of the data is imported. In this report, the original measurement data may be presented also, but this is not necessary. They can always be inspected and interesting parts may be presented in the report.

4. PLANNING OF THE PROJECT

The project has been divided into two phases:

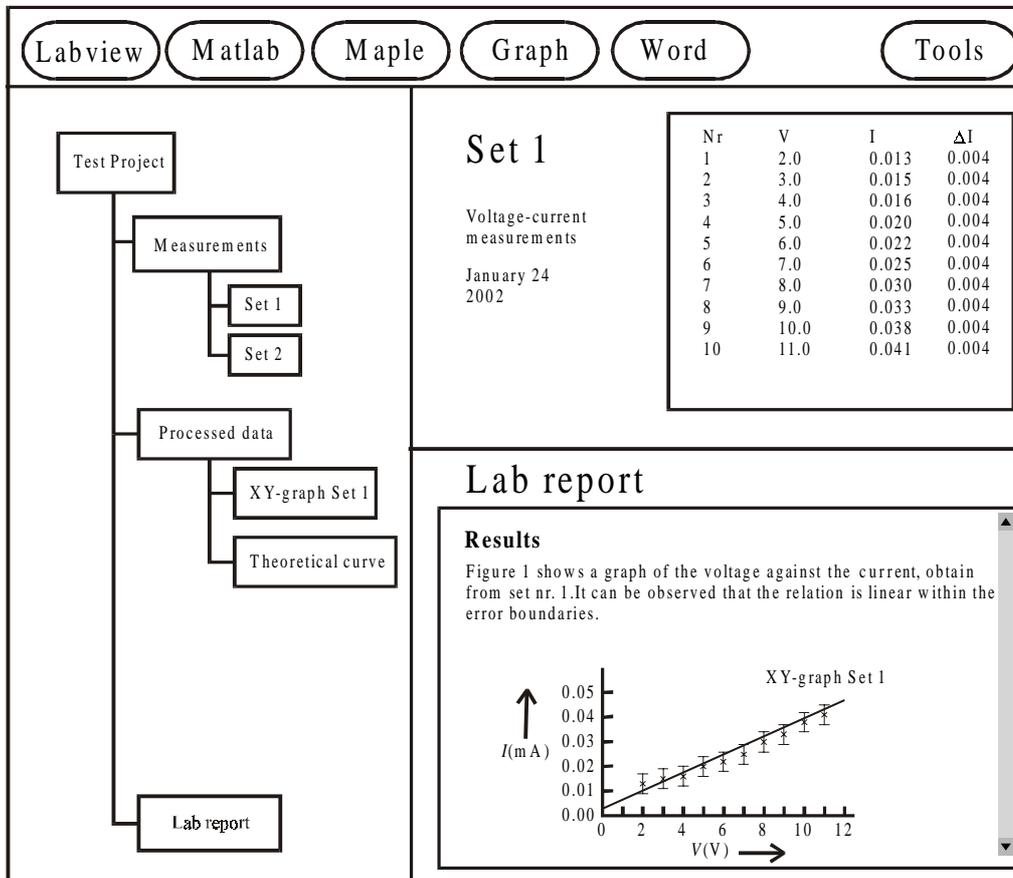


Fig. 2. Sketch of the user interface for doing experiments

1. Tools for making a lab report
2. Data management and software integration

As the user friendliness of the software is extremely important, we have started evaluating the available software for making documents on their ease of use. The aim of this part of the project is to get a set of software tools, enabling students to make a lab report on the computer in a fast and user-friendly way. This set of software tools will be tested during a student project and during a laboratory course. If satisfactory results are obtained, these tools will be integrated and combined with tools for data management during a second phase of the project.

5. CONCLUSIONS

In this paper the problem of reporting about experimental work was addressed. It was observed that the traditional lab report, being written on paper, does not fit the modern framework of experiments, in which the computer is the central tool. Also it was observed that the management of measurement data is neglected often, at least during the university course. A new framework is proposed therefore, in which reporting about experimental work is combined with data management.

The most severe problem may be the fact that making up documents, including equations, drawing etc is a process that is still user-unfriendly and slow. Using a tablet may appear to be a temporary solution, until better software (and hardware) solutions are available.

It was stressed that existing software tools will be used as much as possible. Possibly, only the integrating graphical user-interface will have to be written.