

DATA PROCESSING SOFTWARE FOR INNOVA 1312 GAS MONITOR

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ABSTRACT

The paper describes software that was developed to effectively manage and process environmental data. The data come from a gas monitor Innova 1312, which belongs to basic laboratory equipment of Department of Biomedical Engineering FEEC BUT. The software is designed to operate a large amount of data. For this purpose it was written in Borland C++ Builder development environment and is based on database components. The software fulfils all the necessary common conditions for effective and easy working.

1. INTRODUCTION

The aim of the project was to construct appropriate software that is able to collect and process data acquired by a gas-monitor Innova 1312. The software should be able to make basic statistical and graphical operations on the data and even more to manage a large amount of data, provide a possibility to choose from a wide spectrum of input parameters. Further, it should be well arranged and easy-controllable.

As mentioned above, the data are acquired from a gas-monitor Innova 1312, which is a part of DBME ecological laboratory equipment. The gas-monitor enables to measure concentration of gases, which are able to absorb infrared radiation. The gas-monitor is calibrated for measurement of concentration of carbon dioxide, sulfur dioxide and relative humidity in the atmosphere using appropriate filters.

2. DATA MANAGEMENT

Innova 1312 has its own basic software that enables to export measured data. The data are exported in form of text files. Each text file includes the header of file, the first line of file, and measured values on the other lines. A practical demonstration of a part of an output text file is shown in Figure 1.

Time"	"A: n/a [mg/m]"	"C: SO ₂ [mg/m]"	"W: Water Vapour [vol%]"
18.04.07 11:36:22	744030e-003	136570e-006	620117e-006
18.04.07 11:34:22	736430e-003	618990e-006	620878e-006

Figure 1: Example of an output file exported by Innova 1312.

3. DATA PROCESSING AND CONTROL SOFTWARE

The software was made as a part of a diploma thesis The Meteorological Data Processing [1]. It was designed in Borland C++ Builder in Windows XP operating system. The main application window can be seen in Figure 2. All panels are situated in a single window. Such solution makes software easy to control and compact. Five main panels are labeled with numbers from one to five. The first panel (1) is fully connected with the inner database and allows users to look over values placed inside this database. The panel (3) on the right enables users easily set input parameters - time range for subsequent data processing. The panel (4) contains control buttons for starting the data processing and for exportation of the results. The last one (5) is an input line for user defined SQL expression.

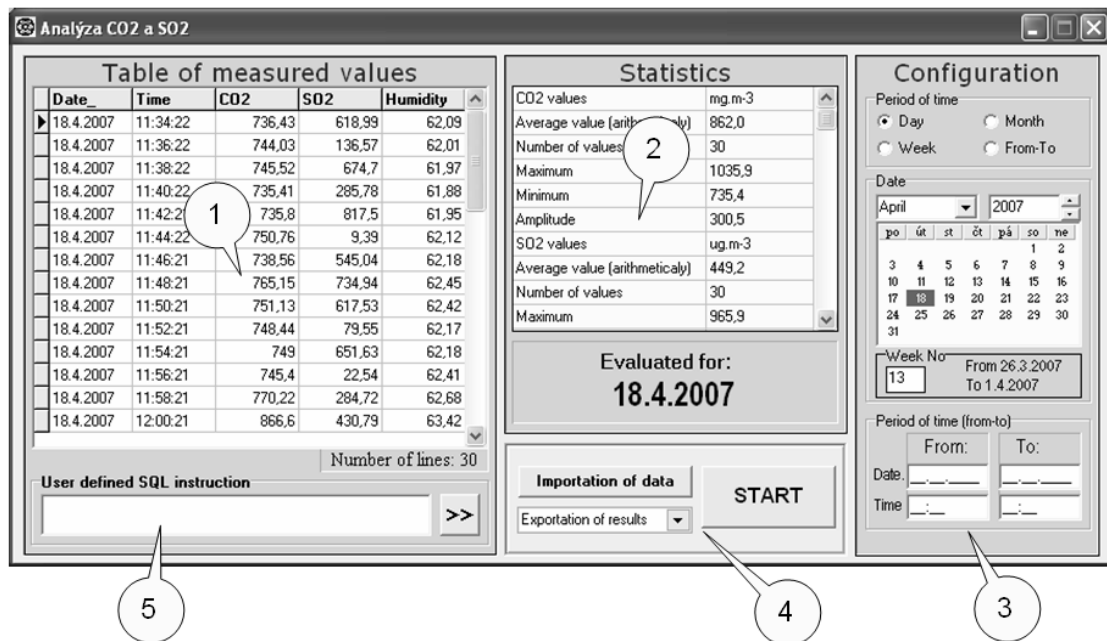


Figure 2: The main window.

3.1. SYSTEM STRUCTURE

The system has to be designed to work properly and precisely. Primarily, it should manage collection, loading and processing of a large amount of values. The measurement interval is two minutes and measurement duration is not limited, so there might be usually from hundreds to thousands of measurement values. For this purpose, the structure is based on database components, which software designers have at their disposal in C++ Builder. The system has two databases of Paradox type on the whole. All values are included in the first - the main database - and the second one is used as a temporary database in case the values are being imported. The database structure is shown in the table below. Number of lines in the database is dependent on the amount of values.

Date	Time	CO2 conc.	SO2 conc.	Relative humidity

Table 1: The structure of the database.

The software is designed as an effective combination of graphic interface, C++ language and SQL language. C++ language is used for connection of graphic interface with all the functions, for database and files communication and many more. On the other hand SQL language manages all processes like keeping, manipulation and processing of measured data values, which are included in the inner database. The block diagram is in Figure 3.

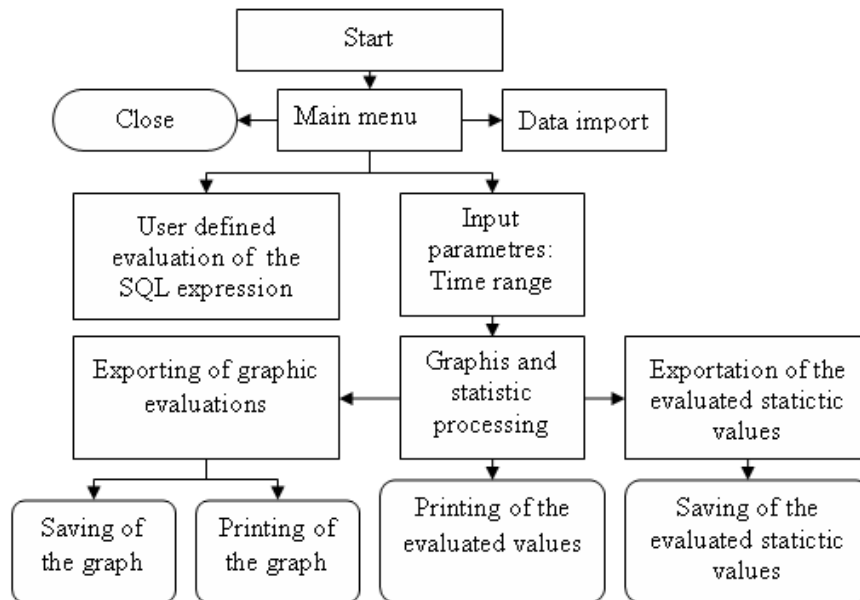


Figure 3: The flow chart.

3.2. MAIN FUNCTIONS

The software is designed for carbon dioxide and sulfur dioxide concentrations and relative humidity data processing. It has three main functions, to:

- import measured data
- do statistic and graphic evaluations,
- export the results.

The importing of measured values to the inner database is being controlled from a separated window (Figure 4). The window allows importing, deleting and editing of input values. When data processing is complete, the graph can be printed or saved as JPEG file, the statistic evaluation can be saved into a text file, excel file or html file. As mentioned, a list of input data used for processing is shown in the left part of the main window and, of course, can be printed too.

The following time ranges can be chosen:

- one day,
- one week,
- one month,
- any time range determined by the exact start and end date and time.

All data operations are performed by SQL language. SQL language is used mainly for measured data importing, graph creating and for statistic calculation.

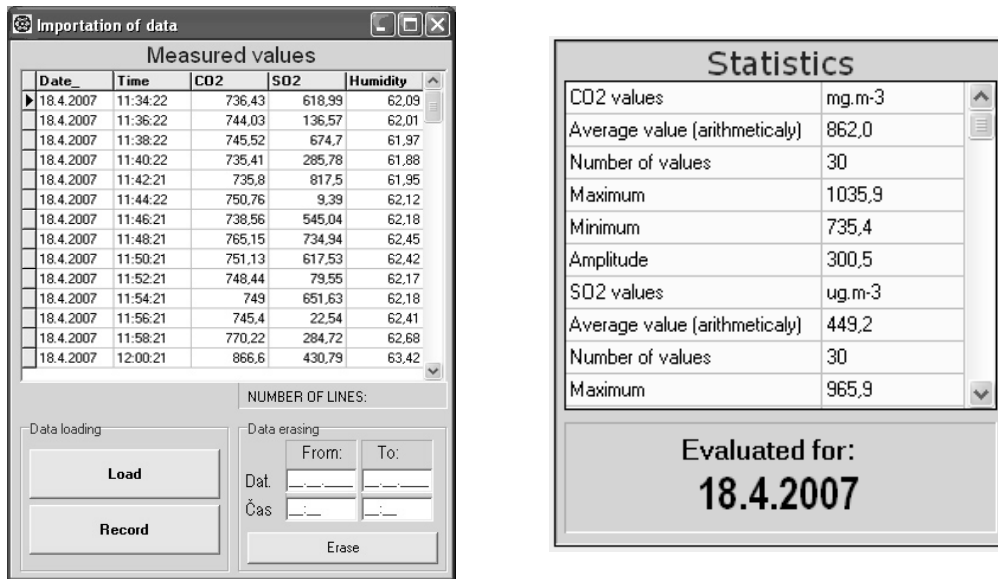


Figure 4: The window for importing data (left panel) and statistic calculations (right panel).

When the data processing is complete, statistic calculations are show in a table in centre of the main window. An example of statistic calculations from 18th April 2007 is in Figure 4. The statistic calculations include arithmetical average value, amplitude, maximum and minimum and the number of input values for relative humidity and both atmospheric gas concentrations. Three new windows with graphs are opened; the graphs represent a development of relative humidity and gas concentrations in time. An example of development of concentration of carbon dioxide in time is shown in Figure 5.

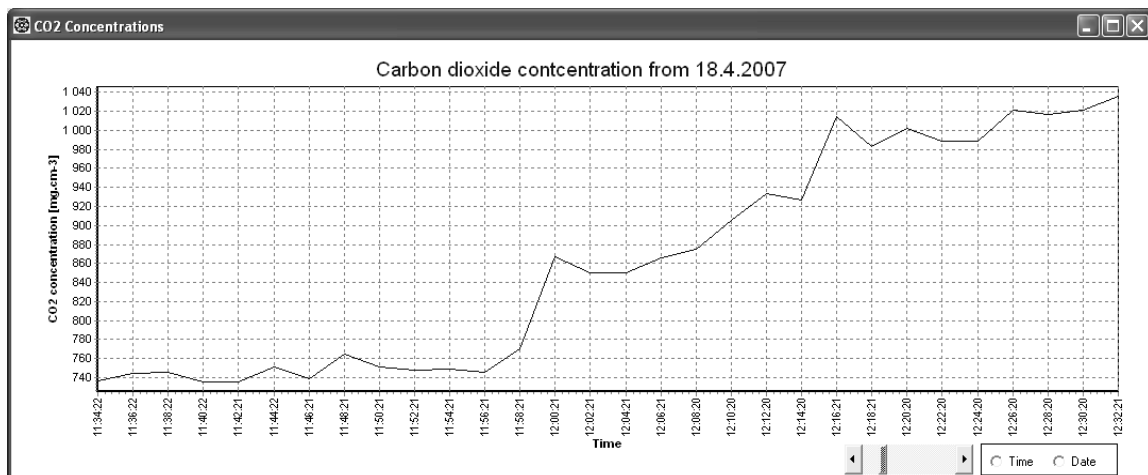


Figure 5: The graph represents development of carbon dioxide in time. The X-axis labels show time intervals and Y-axis shows concentration of carbon dioxide in mg.m^{-3} . The slide in the right below the graph enables to change X-axis label concentration and radio buttons next to the slide enables to change X-axis labels from time to date and back.

In some cases basic calculations mentioned above are not enough. For these cases there is a special function. It enables users to create their own SQL expression and to execute it. Users can use common basic SQL expressions such as SELECT, WHERE, FROM, ORDER BY, BETWEEN, COUNT, AVG, MAX, MIN and many other. This allows showing values and doing calculations in almost any combination. The expression is being set in the editable area in the left-down part of the main window. An example can be seen in the Figure 6.

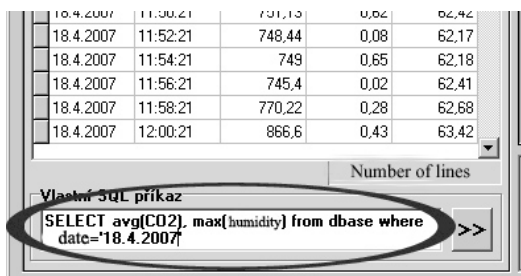


Figure 6: Example of user defined SQL expression placed in the main window.

For example, when there is a demand to execute a complicated calculations like this one: “make a list of values of carbon dioxide from 1st of January 2007 to 11th of January 2007 that were measured at 6 p.m. and at 9:50 p.m. and the values are in the interval from 690 to 745 mg.m⁻³“, it can not be evaluated by standard input set up, but it can be solved by used defined SQL expression. Here is the example above resolved in SQL as is used in the software: „SELECT CO2 FROM DBASE WHERE DATUM BETWEEN 1.1.2007 AND 11.1.2007 AND WHERE CO2>690 AND CO2<745.“

4. CONCLUSIONS

This software was constructed to be capable of making basic data processing acquired from gas monitor Innova 1312. It effectively manages and evaluates a large amount of data. The system was designed in Borland C++ Builder using its database components. Such approach has shown up as a very effective. Operating with data is supported by SQL language. SQL language is used for every operation with data in here, from importing data to the inner database to statistic calculations. In conclusion, the software fulfils all given conditions for effective and easy working. The software is fully documented and a standard software manual and introduction to SQL language use is included in [1].

ACKNOWLEDGEMENTS

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