Integrated GUI based software for data acquisition and analysis of electrochemical gas sensors

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A integrated software for data acquisition and online analysis of electrochemical gas sensor using Visual Basic 4.0 as front tool under Win 95 environment is designed and implemented. The features of the software includes high performance windowing, deluxe tool kit for acquisition, analysis and graphics, menu driven monitoring with display and online integration of various events. It is user friendly, with capability to build and execute customised applications. The software supports good number of hardware which are useful for any research and development environment involved with the sensor related activities.

1 Introduction
Both legislation and marketing factors have greatly influenced gas sensor development in recent years and the state of art achieved technology.1-2. Gas detectors/analysers of which sensor forms the heart, for environmental protection and improved process operation or improved product performance. The current dominant influence with regard to gas detectors/analysers development, without doubt, bring pressure from environmental protection and vehicle pollution control. In addition to this they have potential applications in various industrial, biotechnological, and medical situations.

There has been ever increasing demand for compact, inexpensive solid state chemical sensor for developing a subsystem which detects the gases in real time. The devices utilising electrochemical sensors have received a major share of attention due to: (i) inherent simplicity and (ii) direct electrical output.

Use of computers in new instrumentation from domestic to industrial automation has been the current trend. Such computerised systems have an edge over manual one with increased efficiency and effective data processing which enables optimum analysis of any process.

Testing/characterisation of sensor under various physical conditions is one of the crucial stages in sensor development. A computer automated system for such activity not only obviates human error but also increases the efficiency. Moreover, such system allows scientists/engineers to concentrate upon his research and development work by obtaining online data and subsequent analysis of sensor at his finger tip.

All above factors prompted us to develop a computer automated system for the characterisation/analytical analysis of a gas sensor.

2 Firmware Requirement
The entire automated system (work station) comprises three important subsystems viz: (i) gas mixing, (ii) temperature of sensor and (iii) sensor emf data acquisition (Fig. 1). A proper linking or communication between these systems can be achieved through any commercially available ADC (analog-to-digital converter), DAC (digital-to-analog converter) and IEEE-488 GP-IB, parallel interface cards. Details of these subsystems are as follows:

The electronic mass flow meters/controller of gas mixing subsystem operates on the principle of magnetic valve. The opening of solenoid valve can be controlled by applying an appropriately calibrated voltage which enables gas to flow with the required rate. The mass flow meter/controller, obtained from Teledyne Hastings (USA), can be operated in the range from 1 SCCM (standard cubic centimetre per minut) to 10 SCCM with an accuracy of 1 SCCM flow rate. By adjusting the gas flow rates through the controllers, the required blend can be obtained at the outlet of mixer. The calibrated
Fig. 1 — Schematic diagram of a computer controlled gas sensor characterisation work station.

voltages can be generated with the help of DAC card (gas mixing subsystem of Fig. 1) installed in the internal bus of the computer. An analog output obtained following PID algorithm is used to maintain the set temperature of sensor (sensor heating subsystem of Fig. 1). The emf of the sensor can be measured either with the help of buffer amplifier (with very high input impedance, $10^{12}$ Ω) and ADC card, or Keithley 617 electrometer (for that matter any other voltage measuring instrument with GP-IB capability) and IEEE-488 GP-IB, a bidirectional parallel interface card (data acquisition subsystem of Fig. 1).

3 Software implementation

What is the right software? The software includes all tools which a developer needs to build and execute applications. It should also support the necessary hardware and allow application to grow as per need. Moreover, it should be user interface that fits end users software. The software used up till now are CUI (Character User Interface) based; though they are menu driven their application orientation are not considered at all. Introduction of WIN 95 a 32 bit GUI (Graphical User Interface) based operating system in the world of computer made a drastic change in development of application oriented software. Visual Basic 4.0 is a new 4 GL language, which is a major breakthrough in application oriented software.

The flow charts of gas mixing, sensor heating and data acquisition subsystems are depicted in Figs 2-4. The main programme (Fig. 5) integrates these subsys-
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Fig. 3 — Flowchart of heating subsystem

Fig. 4 — Flowchart of data acquisition

Fig. 5 — Flowchart of main programme

The GUI based software can be effectively used for automated testing and analyses of sensor. It facilitates data retrieval and online analyses effectively, following graphical and/or analytical procedures. The output can be taken onscreen/to file/hard copy.

It is the right software as it is user friendly to build and execute applications. Having a good hardware support, it is very useful for any research and development environment involved with the sensor related activities.

Additional advantage of this is that the same algorithm may be used to design the most awaited research and development tools for testing, calibration and analyses. Various features of the software include:

1. High performance windowing
2. Deluxe tool kit for acquisition, analysis and graphics, menu driven monitoring and display
3. Online integration of various events

4 Conclusion

The GUI based software can be effectively used for automated testing and analyses of sensor.
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