MOBILE MEASUREMENT SYSTEM FOR MECHANICAL EXPERIMENTS
WITH INTERNET CONTROL AND AQUSITION CAPABILITIES

Łukasz Maciejewski MSc, Przemysław Wiewiórski MSc
Wrocław University of Technology, Institute of Materials Science and Applied Mechanics,
ul. Smoluchowskiego 25, 50-370 Wrocław, Poland

1. System overview

1.1 Input devices

Sensors like termocouples, magnetoresistors, extensometers and output signals of force and displacement from material test system like MTS-810 could be connected. Sensor types depend on amplifiers that the range of return voltage signal is -10 -- +10V.

1.2. An industrial controller and its expansion modules

The system is partially based on industrial controller provided by WAGO company. Implemented Modbus/TCP protocol enables communication between external systems and expansion modules connected to the controller as well. There are several types of expansion modules ie. analog I/O, digital I/O, termocouple interfaces and more that make the system easily scalable and developmental.

1.3. Acquisition and control application

Acquisition and control application is built in VEE visual programming language. The application communicates with controller module via Modbus/TCP protocol. As Modbus protocol is not natively implemented in the VEE environment it was necessary to develop dedicated communication functions based on sockets TCP protocol.

Data acquired from the controller are displayed in plots that correspond to appropriate inputs. The application also provides functions of equipment control. In present state it's possible to simply turn on and off selected devices by digital outputs.

1.4. Web interface

Internet interface is provided by the dedicated web site. It gives the opportunity of observing real time plots of experimental data. Monitoring of modules outputs and inputs is also possible by built in the industrial controller web server. In fact the industrial controller web server has limited connection capabilities. Therefore it was necessary to develop dedicated Internet site located on more powerful web server. Data served to the Internet users is transferred to the server from the acquisition application in plain text or binary files that are then processed by Java applets.

1.5 Communication of sub-systems

Presented system is set up from the following hardware essentials:

- sensors and actuators,
- dedicated signal amplifiers,
- 16-bit A/D converters
- industrial controller and its expansion modules,
- web server,
- optional battery power supply,
- optional wireless communication devices.

The functional scheme of the system is shown on the figure 3. Analog inputs acquire electrical signals from sensors. Gathered data are stored in so called process image in memory of the controller. Access to this process image is possible via the controller and Modbus/TCP protocol.

Control functions of the system are realized by digital outputs. Digital inputs realize the trigger functions in the system.

2. Application in experimental mechanics

System was successfully applied in standard mechanical experiments like tension and compression tests. Tests may be accompanied with magnetic field and temperature measurement. Another application was monitoring of a steel plates pressing process. Example results are shown on figures 1 and 2.
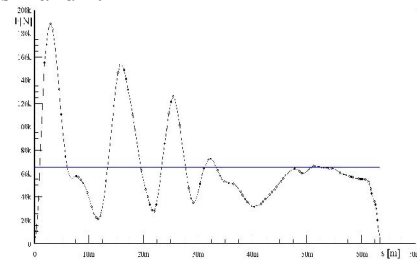

Fig. 1 Sample results of load spectrum taken from the acquisition application

Sampling capabilities (up to 5 samples pre second) of used analog inputs are the only drawback. In present state the system can not be applied in rapidly changing processes but faster analog inputs are available so further development is possible.
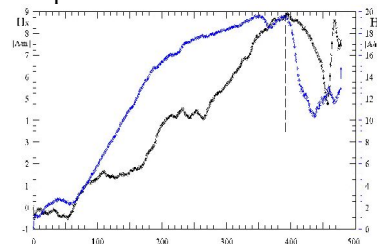

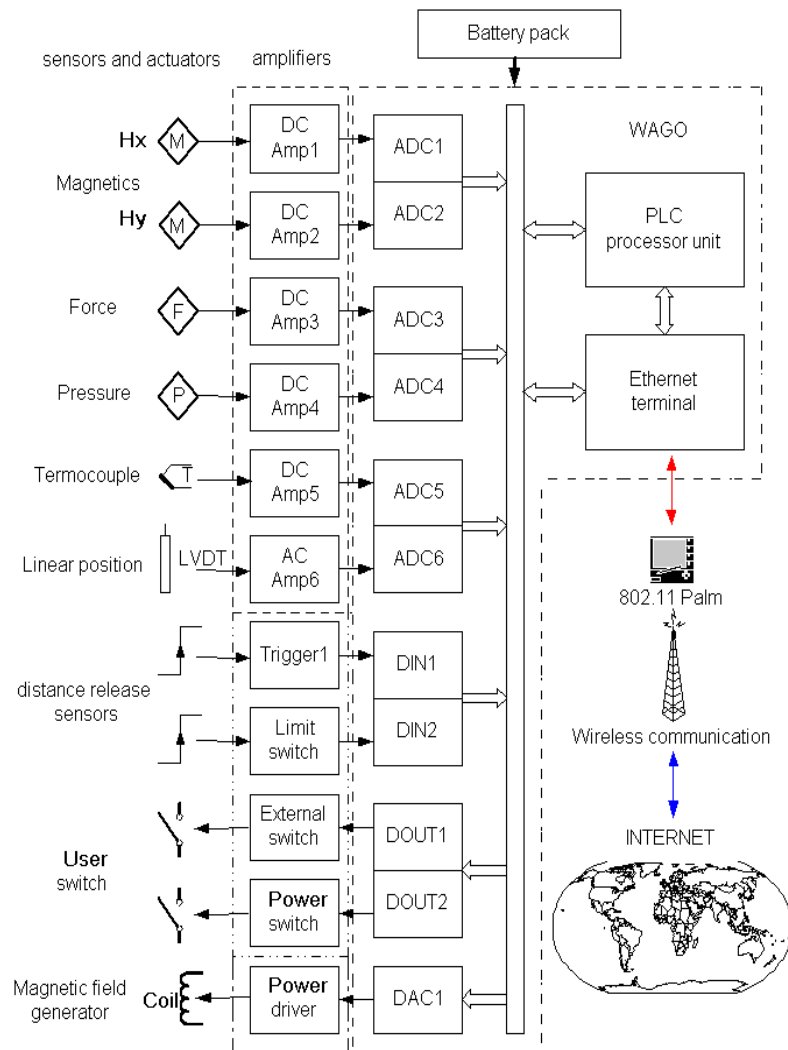*Fig. 2 Sample results of magnetic field measurement*

Fig. 3 The functional scheme of a mobile measurement system

3. References

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