AUTOMATED WIRELESS SYSTEM FOR MEASURING ENVIRONMENTAL PARAMETERS BASED ON NI MYRIO PLATFORM

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Introduction

The problem of measuring environmental parameters such as temperature, humidity, pressure, illuminance, is relevant in the following areas of activity:

– control of working conditions, conditions of production and storage of products in premises;
– environmental monitoring;
– meteorological observations and forecasts;
– ensuring the uniformity of measurements during verification and/or calibration of measuring instruments.

Reduction of labor and time costs for the organization of measurements can be achieved by automatization of the process of collecting, processing and saving measurement data.

The aim of the work is the development of an automated wireless system for measuring environmental parameters (WSM) based on the NI myRIO platform.

Features of the system for measuring environmental parameters

WSM should be characterized by the following features:

1) *Mobility.* This characteristic is provided by the use of wireless data transmission from the measuring node of the WSM to the computer and by comparatively small overall dimensions.

2) *Scalability.* It is possible to expand and modify the measuring part of the system (adding or removing sensors) without making essential changes to the program code.

3) *Modularity.* The modular structure of the software allows the use of WSM individually or as a module of other systems.

4) *Parallelism.* This property is achieved by having a set of sensors working in parallel via multiple channels.

5) *Automatic generation of reports.* The measurement protocol is saved to a file of Microsoft Excel format. The file contains all the necessary information in a form convenient for further processing and usage.

Structure of the system for measuring environmental parameters

The general view of the WSM structure is shown in figure 1. The system is implemented on the basis of National Instruments myRIO (NI myRIO) platform. NI myRIO is a portable reconfigurable input-output device, which may be used for design of systems of control, robotics and mechatronics [1].

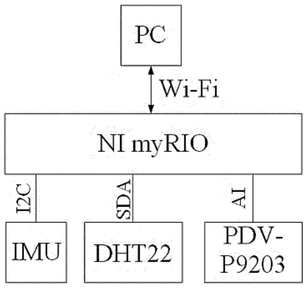

Fig. 1. WSM structure

WSM is intended for measurement of four physical quantities: temperature, pressure, humidity and illuminance. The Inertial measurement unit (IMU-sensor) is used to obtain pressure and temperature values. The LPS331AP microcircuit, which is a part of the IMU-sensor, contains an ultra-compact piezoresistive absolute pressure sensor and a semiconductor temperature sensor [2].

Capacitive humidity sensing digital temperature and humidity module DHT22 was selected to be a humidity sensor. The sensor is connected with a high-performance 8-bit microcontroller and includes capacitive sensor wet components, high-precision temperature measurement devices [3].

The light sensor is a PDV-P9203 photoresistor. A photocell is a two-terminal device fabricated from cadmium sulfide with resistance that varies with illumination changes in the visible spectrum from 400 to 700 nm.

Data transfer from the sensors to the NI myRIO is implemented by means of various protocols. The absolute pressure and temperature IMU-sensor transmits data via the I2C interface. Capacitive humidity sensing digital temperature and humidity module DHT22 uses a simplified single-bus communication SDA. Photoresistor PDV-P9203 transmits data over an analog channel (AI). In turn, the data from the NI myRIO is transmitted to the personal computer via the wireless interface IEEE 802.11 (Wi-Fi).

The metrological characteristics of the developed WSM are presented in table 1.

Table 1. Metrological characteristics of the WSM

Characteristic, unit	Value
Temperature measurement range, °C	from minus 40 to 85
Limit of absolute error of temperature measurement, °C	± 2
Pressure measurement range, mm Hg	from 195 to 945
Limit of absolute error of pressure	± 1,5

measurement, mm Hg	

Continuation of table 1

Characteristic, unit	Value
Humidity measurement range, %	from 0 to 99,9
Limit of absolute error of humidity measurement, %	± 2
The spectral range, nm	from 400 to 700
Sensitivity of illumination measurement, Ohm/lux	0,9

Figure 2 shows photo of system for measuring environmental parameters.

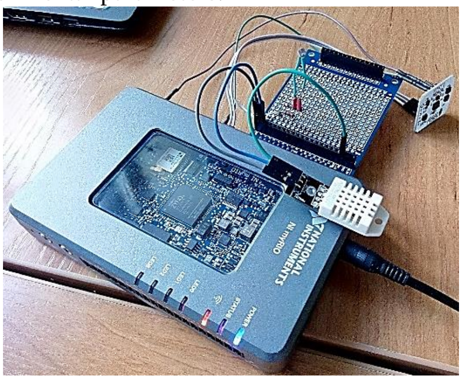

Fig. 2. Photo of WSM

System software

The LabVIEW graphical environment was chosen for the system software development, which was carried out in accordance with a modular approach. Since the temperature and pressure data are obtained from the same sensor, the developed program includes a temperature and pressure measurement module, a humidity measurement module and an illumination measurement module. All software modules have the same operation principle: sending a request for data transmission to the sensor, receiving and processing information. Each module has its own features of this operation sequence depending on the data transfer protocol.

Since all three sensors use FPGA to communicate with the NI myRIO, data transfer processes from all three sensors have been synchronized through the function blocks of the Semaphore VIs palette which allow to limit the number of tasks that can simultaneously work with a shared resource.

Figure 3 shows a fragment of the front panel of the program. The user needs to set the following parameters: number of measurement, measurement rate, need of displaying seconds in the table, path to saved file with the measurement results.

All measurement data are summarized in table, containing information about the measurement date, time and measured values, which is also automatically saved to file. In addition to the table on the front panel, the data are displayed as updated in real time graphs showing the dependence of each measured quantity on time.

Conclusion

Developed automated wireless system for measuring environmental parameters based on the NI myRIO platform allows to obtain measurement data about temperature, relative humidity of ambient air, atmospheric pressure and illumination in real time with a specified measurement rate.

System for measuring environmental parameters meets the requirements of mobility, scalability, modularity and parallelism. It can be used as a meteorological station or module in the "Smart Home" system, as well as for controlling the microclimate parameters in the premises and influencing quantities during verification/calibration of measuring instruments.

References

1. NI myRIO [e-resource]: URL: http://www.ni.com/myrio/ (Дата обращения 01.05.2017).

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3. DHT22. [e-resource]. – Режим доступа: www.aosong.com/, свободный. – Загл. с экрана. – (Дата обращения 01.05.2017).

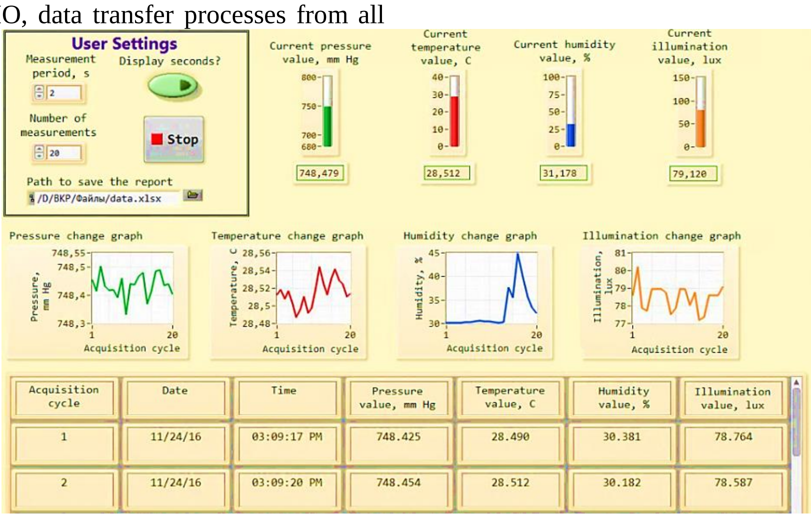

Fig. 3. A fragment of the front panel of the program