Sensor elements based on nanostructured materials for implementation in portable measuring system

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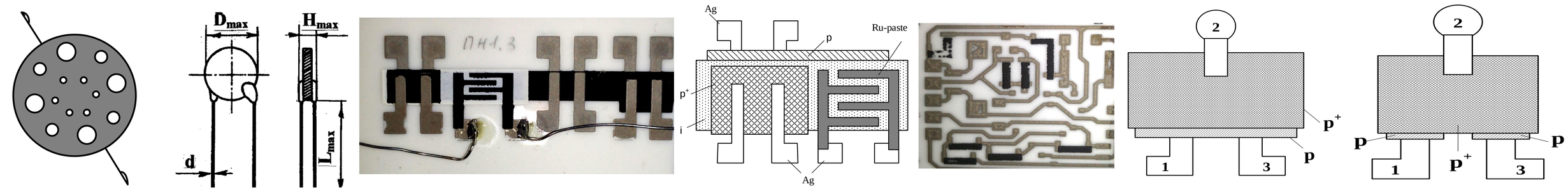
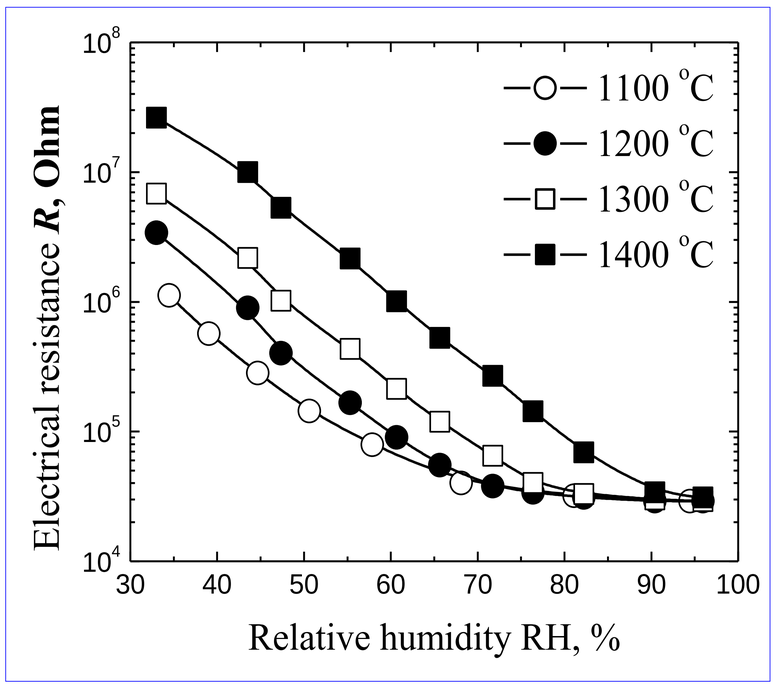
The nanostructured humidity-sensitive sensors based on $MgAl_2O_4$ ceramics in bulk performance and temperature-sensitive multilayered thick-film sensors of different design based on semiconducting $Cu_{0.1}Ni_{0.1}Co_{1.6}Mn_{1.2}O_4$ and $Cu_{0.1}Ni_{0.8}Co_{0.2}Mn_{1.9}O_4$ ceramics were fabricated and studied. It is shown that temperature-sensitive thick-film sensors possess sensitivity in the region of 298…358 K and humidity-sensitive sensors are sensitive in the region of 30…98 %. Designed sensors were used in the portable system realized on Arduino for monitoring and control of microclimate parameters. Obtained system were tested using Android application.

Nanostructured ceramic-based sensors

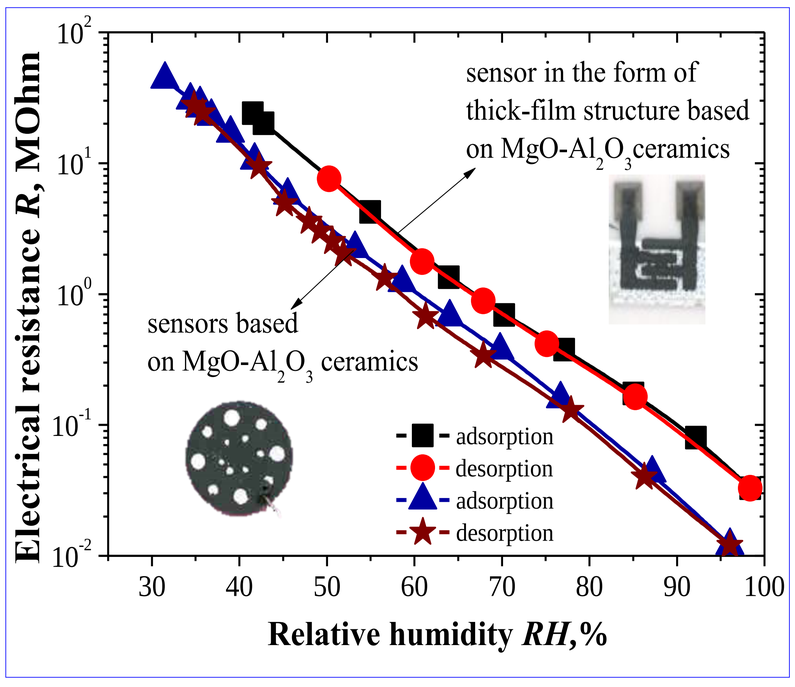


View and construction of bulk humidity and temperature sensors, temperature-sensitive thick-film and integrated temperature-humidity-sensitive structures

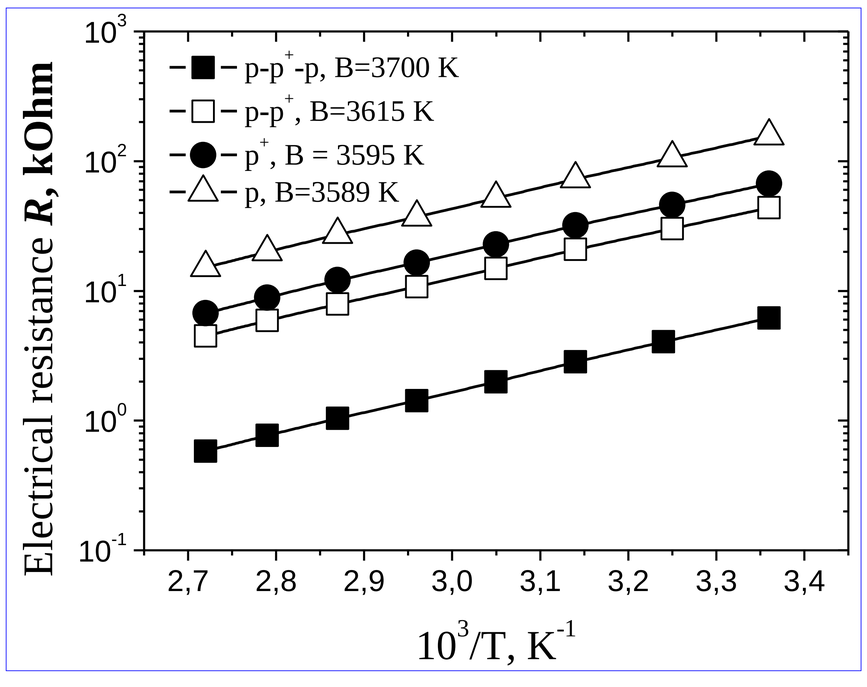
Exploitation properties of sensors



Dependence of electrical resistance from relative humidity for ceramic-based elements obtained at 1100…1400 °C



Comparison of exploitation properties for design humidity sensors in the form of thick-film structure and initial humidity sensors based on bulk ceramics

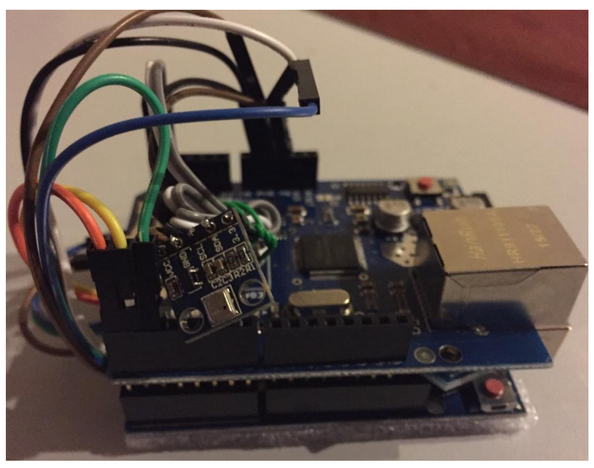


Dependence of electrical resistance from temperatures of for temperature-sensitive p- and p^+-conductivity thick-film elements and double- p-p^+ and triple-layered p-p^+-p structures

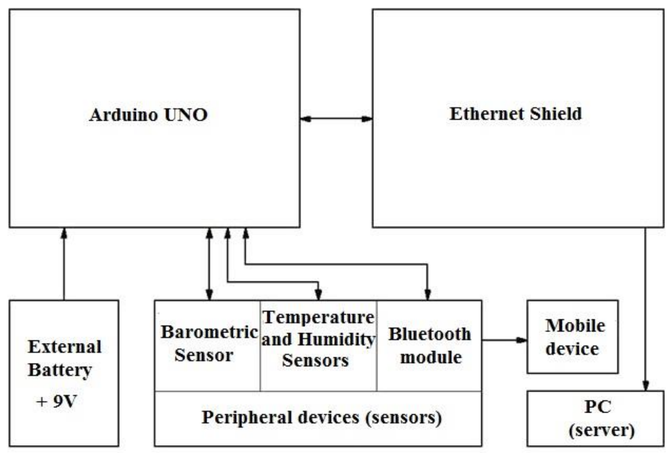
Adruino-based portable system for microclimate monitoring

Obtained in this work humidity- and temperature-sensitive sensors were used in measuring systems for temperature and humidity monitoring.

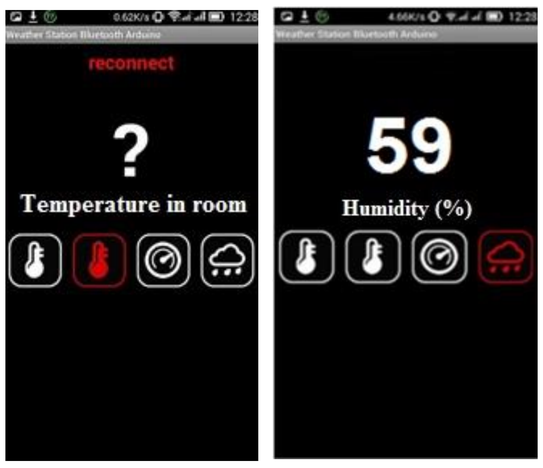
In general, the developed system contains of two main boards: Arduino Uno and Ethernet Shield, as well as obtained and investigated sensors in bulk and thick-film performance. Ethernet completely covers the useful space and have the same Arduino ports to connect peripherals, all sensors are connected directly. In the present configuration of the device, only one resistor was used, since most of resistors, capacitors, coils on the inductor are already within the desired peripheral or Arduino.



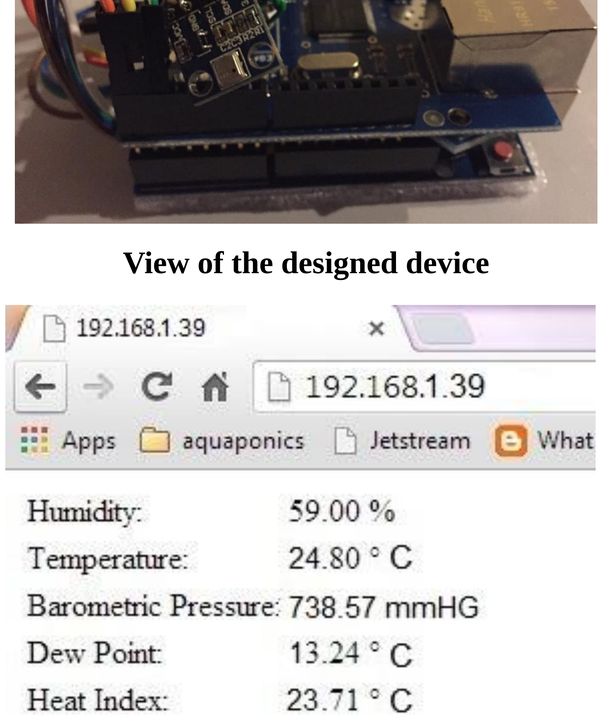
View of the designed device



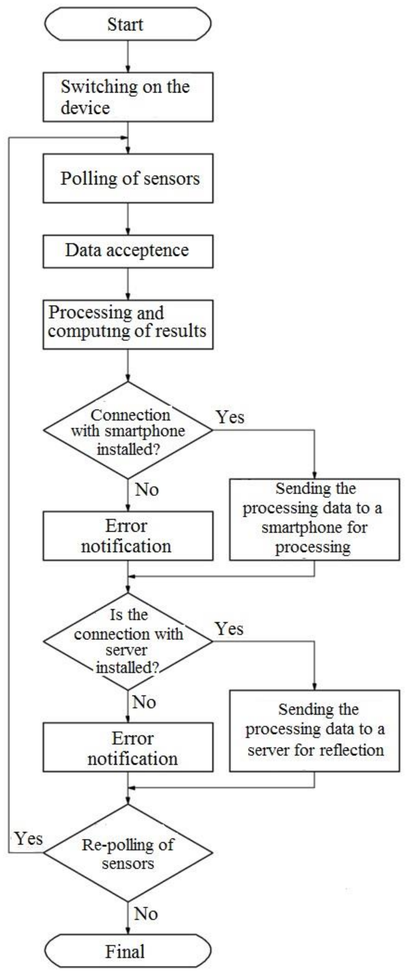
Functional scheme of portable prototype of meteorological data acceptance



Appearance of the application to mobile device screen on Android OS



Displaying data on a server



Algorithm of the work of portative device

Conclusion

Nanostructured bulk and thick-film humidity-sensitive ceramic-based sensors sintered at 1100…1400 °C and temperature-sensitive thick-film sensor structures in different design based on $Cu_{0.1}Ni_{0.1}Co_{1.6}Mn_{1.2}O_4$ and $Cu_{0.1}Ni_{0.8}Co_{0.2}Mn_{1.9}O_4$ ceramics were prepared and studied. It is established that temperature-sensitive thick films are sensitive in the region of 298…358 K. The increasing of thick-film layers results in rises of temperature-sensitivity of sensor elements. The best humidity-sensitive of ceramic sensors sintered at 1400 °C were obtained at 30…98 %. Obtained sensors were used in portable measuring system for environmental monitoring for Android OS.