Sensor Network Based on Gas Smart Sensors for Environmental Monitoring

Zinoviy Mykytyuk, Andrij Fechan, Olga Shymchyshyn, Andriy Rudyi, Vasyl Nazarenko, Vasyl Petryshak

Abstract – **This work describes the structure of the real time environmental monitoring automated system on the basis of the network of liquid crystal optical gas sensors. There were proposed principles data gathering from distributed objects.**

Keywords – **smart sensors, environmental monitoring, microconroller, fieldserver, liquid crystal.**

I. INTRODUCTION

Detection of harmful gases in the air becomes important in the context of recent developments in environmental and technogeneous safety. Therefore, most of the efforts are devoted to development of low-cost and compact devices which are able to detect the presence of these materials. Sensors with an integrated microcontroller or microprocessor, the so-called smart sensors, have more advantages over conventional sensors [1-2], because they can perform more functions, such as self-identification, self calibration, and can make sensor networks, or be a part of so-called "field servers" [3]. These are so-called robotic field observation posts, which consist of a set of different sensors with built-in web-server and ip-camera. There are also built-in Ethernet Local Area Network (LAN) and WLAN modules, providing a wide range of monitoring in real time as well as the ability to transmit information via the Internet to an automated system for environmental monitoring.

Today in Ukraine there are almost no functioning systems for automated environmental monitoring. In this direction there were implemented several pilot projects [4-6].

II. RESULTS AND DISCUSSION

The monitoring system receives data from a network of optical gas sensors with a liquid crystal as a primary transducer [7-9]. Block diagram of the sensor is shown on Fig.1. Non-optical type sensors are relatively expensive and usually are complicated in assembly. However, optical sensors can be produced with relatively simple design. The application of multisensory system provides better selectivity, because one sensor does not respond selectively to one gas in the mixture, such as carbon dioxide, but also to other gases. Therefore, additional sensors help to improve the efficiency of detection. The secondary transducer is built on the basis of programmable microcontroller PSoC, block diagram is shown on Fig.2. PSoC microcontrollers are designed to replace traditional microcontrollers and reduce the number of discrete components around them.

This architecture allows to create own peripheral configurations which meet requirements of each application and can extend the functionality of the device by modifying the software and use idle internal devices. For example, it is possible to add into the system the complex of sensors for concentrations measurements of ammonia NH_3, nitrogen dioxide NO_2, hydrogen sulfide H_2S and other materials that make these systems indispensable at production.

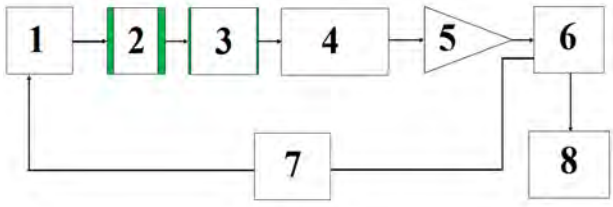

Fig.1. Block diagram of LC sensor:
1- ligt sourse, 2-exemple, 3-photodetector,
4-programmable amplifier, 5-ADC,
6-processing unit, 7-control unit, 8-indication unit

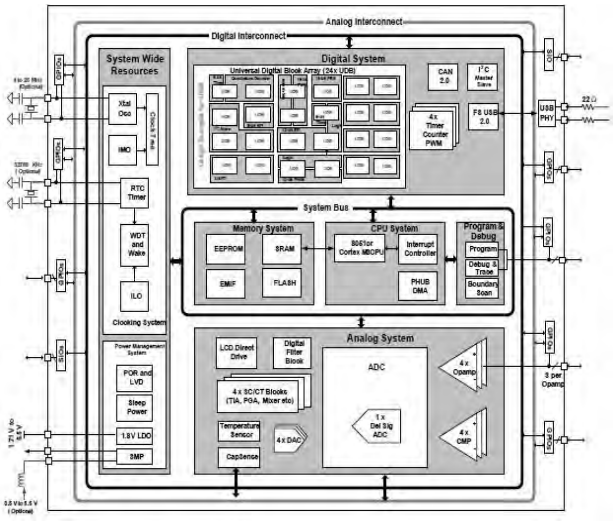

Fig.2. PSoC block diagram

The structure of proposed automated system for air pollution monitoring is shown on Fig.3. There can be unlimited number of automatic posts in the system. For communication with Web-server there are used standard types of the Internet connections. Remote Web-server consists of two components:

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- hardware subsystem;
- Top-level software.

The hardware subsystem is a computer connected to the Internet through a modem or any other device. The physical location of the hardware part of the Web-server does not matter. This may be a computer at the university as well as any Internet provider's server. The only important thing is an access to that server form the Internet.

The top-level software is a part of the automated monitoring system's software and its structure and algorithms are defined by system's tasks and functions of processing, storage and presentation of the information.

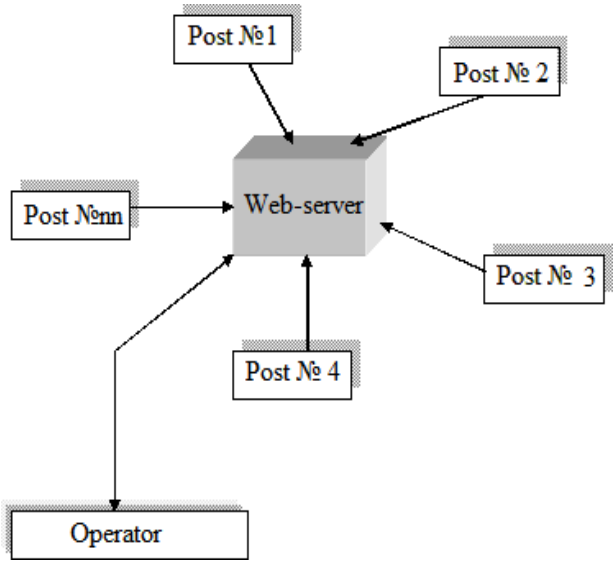

Fig.3 The structure of the automated monitoring system

The work of top-level software provides the following software components fig.4

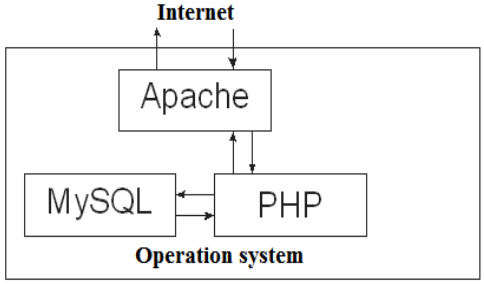

Fig.4. Software elements of the top-level

Relational MySQL database provides storing and presenting information on the queries language SQL. Apache server is used for communication between computers over HTTP interaction with MySQL and the programming language PHP.

III. CONCLUSION

The proposed method of optical smart sensors network assembly and the topology of automated system for environmental monitoring make it possible to track the condition of air in the workplace or living space in real time. Moreover, application of inexpensive optical sensors based on liquid crystals and with own design provides the ability to create a new automated system for monitoring atmospheric pollution, inexpensive, reliable and able to perform continuous automatic control and at the same time corresponding to demands of Ukrainian market.

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