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MEASUREMENT OF STRATIFIED TEMPERATURE IN INDUSTRIAL INTERIORS

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ABSTRACT
The paper deals with development of temperature measurement in some industrial interiors. This problem has connected to solving, so-called temperature comfort of a man in interiors of the buildings. The problem has name: the distribution of temperature in the height of industrial hall. Modern integrated semiconductor sensors are used there. Requirements on this measurement demand specific approach because of non-uniformly distributed temperature in high industrial halls. Therefore solution implementing measurement in more points at different heights, remote transfer and observing obtained data with LAN or Internet technology. A prototype of device was designed with regard to linearity of I/O characteristic, sensitivity and accuracy, remote observing with possibility of control. Preliminary conclusions show that mobility of device and feedback control for correction of large temperature differences and improvement thermal comfort of a man in observed interiors of buildings.
Keywords: measurement, temperature, temperature distribution in interior.

1. INTRUDUCTION
One of many nowadays trends is to create an optimal conditions for stay of a man in environment (at workplace or at home). These conditions are designed to provide better physical and mental equilibrium. It is to ensure thermal comfort of a man in interior. [1]
Thermal comfort of a man in interior means to find optimal parameters of inner dwelling space. The parameters are air temperature, mean radiant temperature, air humidity, air velocity and others. [1]
Most of these physical quantities are commonly measurable but it is sometimes arises problems concerning with measurement and evaluation. Measurement and evaluation of temperature in interiors is such specific problem. This specific problem is measurement of uneven temperature distribution in space which is often seen in higher hall where temperature difference between floor and ceiling can be up to +/0 10.0°C (see Fig. 1)
It is necessary to sense the temperature in several points at different highs and to obtain complete view about temperature distribution in whole industrial interior. Possible solution of this problem is shown in this paper.

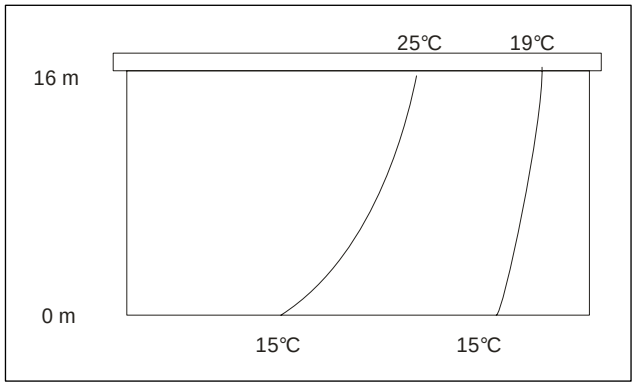

Figure 1. The scheme of uneven temperature distribution in halls

2. DESIGN OF SENSING AND MONITORING SYSTEM OF TEMPERATURES IN INDUSTRIAL INTERIORS

The scheme of designed measurement and acquisition system is shown in Fig. 2.

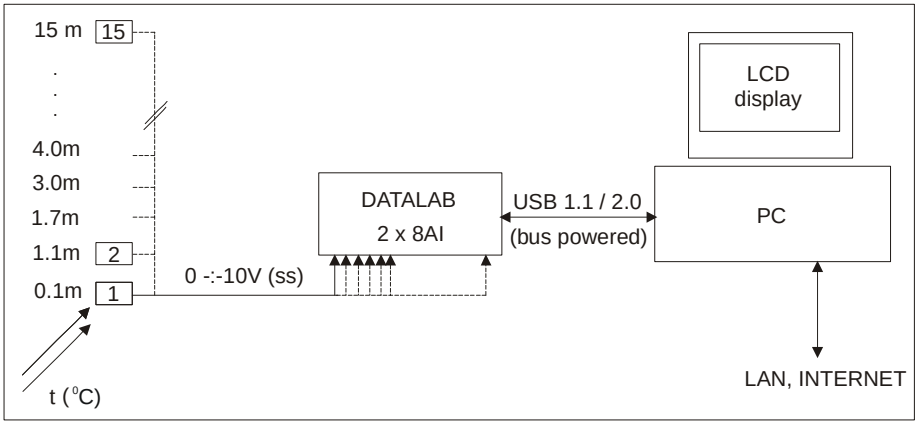

Figure 2. Block scheme of measurement and acquisition system

The measurement of temperatures according to Fig. 2 is solved with AD590 semiconductor integrated circuits. The sensors are situated in the height of hall. The concrete positions are projected in height: 0.1m, 1.1m, 1.7m, 3m, 4m, 5m, 6m, 7m, 8m and 9m up to 15m. The first three sensors are installed in the heights 0.1m, 1.1m and 1.7m meter above the floor. It is necessary to define temperature for foot (0.1 meter), for head of sitting man (1.1 meter) and for head of standing man (1.7 meter). Other sensors are installed from 3 meters to 15 meters by 1 meter.

The semiconductor sensor AD590 has a current output signal. Therefore this output is converted from current to voltage signal by resistor R*.

Measured system is shown in Fig.3. It is a cable system put up in the height of hall from air-ball. The cable carries the sensors in certain heights. There are resistant elements and connector used for connecting to PC in the down position.

The voltage signal is conducted into a unit DATALAB and connected to the analogue inputs. The unit does automatic measurement of all inputs, acquisition, evaluation, archiving and communication through the Internet. The acquisition data is achieved in DataLab at setting time period, e.g. a 15 minutes. The data is sent through the Internet. The DataLab is connected by PC to Internet server which is used for the communication.

DataLab unit communicates with PC through USB (Universal Serial Bus) 1.1 or 2.0. USB connector is also used to supply of external units directly from PC. Alternative is to supply external devices with 10-40V DC adapters. This is usually used if USB supply is insufficient. Analog inputs at these units are differential and can be used for 0 to +/-10V DC or for 0 to +/-20 mA [5]

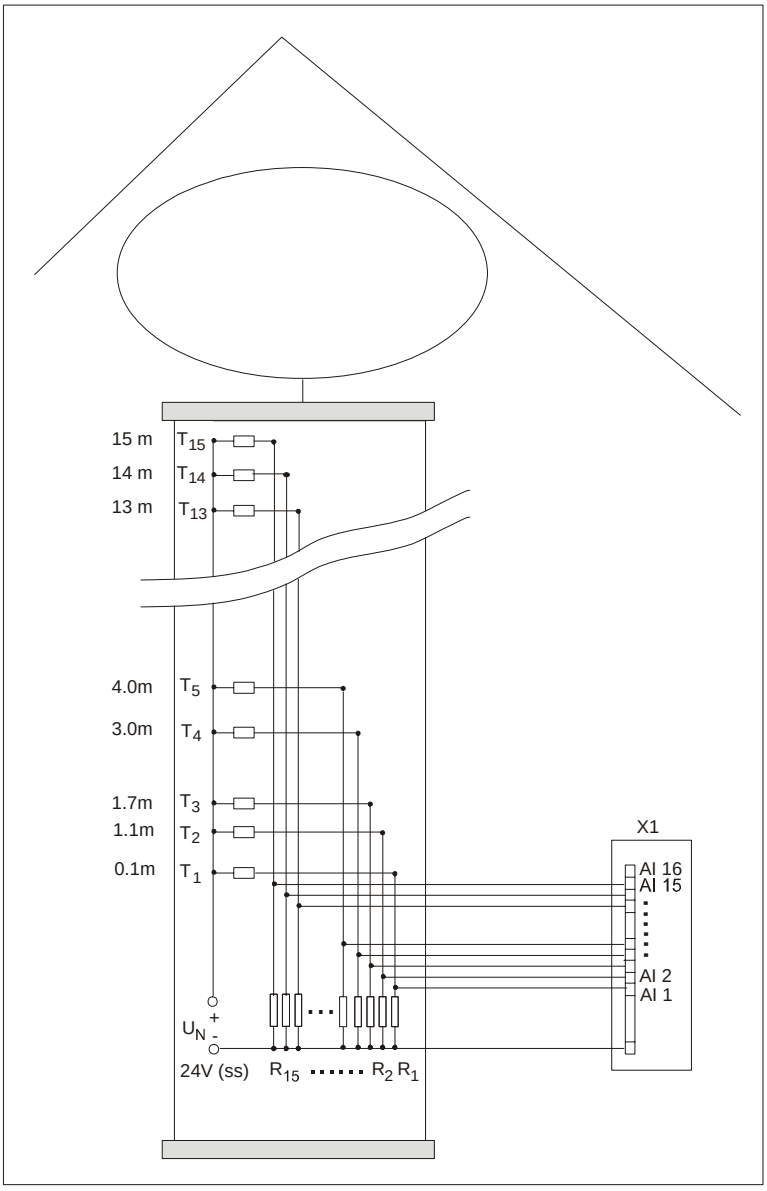

Figure 3. Scheme of temperature measurement in interiors

DataLab units are equipped with special digital I/O or with separated DI and relay DO when regulation function is needed. [5]
PC should be equipped with software appropriate for communication with DataLab eventually for controlling. The suitable software for these puposes is objected oriented interface ControlWeb recommended by DataLab manufacturer. The acceptable operating software for PC is Windows XP Professional that can recognize and automatically install units. The combination of PC with DataLab makes it possible to collect, evaluate and store data obtained by measurement. Furthermore it ensures remote monitoring and controlling via LAN or Internet.
A modification of project is a design of measure system only tree down temperature in the heights 0.7m, 1.1m and 1.7m. The scheme is shown in Fig. 4. The functions of measurement and acquisition are equal.

3. INTEGRATED SEMICONDUCTOR SENSOR AD590

The measurement of the temperature is designed for semiconductor sensor, the type AD590 from Analog Devices. The measuring loop for the sensor is created according a scheme in the Fig. 6.
The AD590 has two pins. The first pin is used for supply power (+4 …+30V DC). The second pin is output with linear current signal 1 μA/K. The measuring range is from -55°C to 150 °C. Linearity of

sensor is in all range and is about +/- 0.3 °C. The circuit is calibrated with laser beam a therefore its accuracy is about +/-0.5 °C. The measuring loop for the AD590 is shown in fig. 6. The AD590 is monolithic integrated semiconductor chip. This chip is used without external compensating circuits. It is fabricated in some modifications, e.g. TO-52 or SOIC-8.

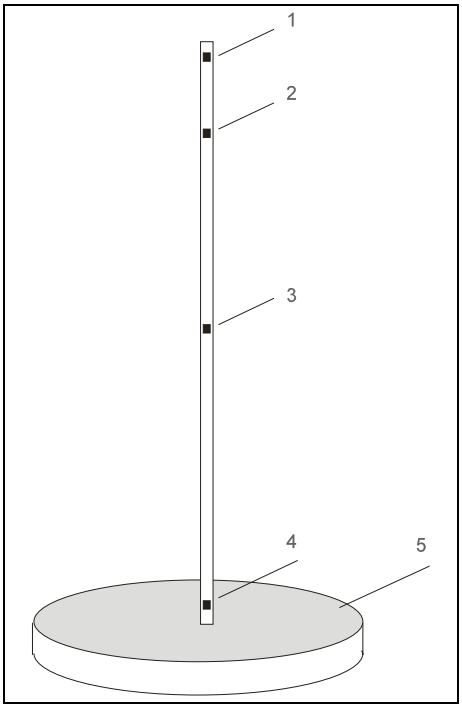

Figure 4. Scheme of temperature measurement unit in interiors

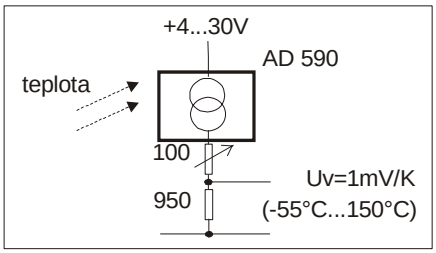

Figure 5. The measuring loop of temperature for sensor AD590

4. CONCLUSION

This paper describes a problem of measurement and acquisition of temperature stratificated in high hall. The application is applied in thermal comfort assessment. The work is in state of design and realization of project. Further work will be verification of proposed measurement system.

5. AKNOWLEDGEMENT

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6. REFERENCES

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