Information-Measurement and Control System “Smart house” as Object of Practice-Oriented Training of Master’s Degree “Instrumentation Technology”

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***Abstract* - The principles of the comprehensive practice-oriented training of bachelor’s and master’s degree “Instrumentation Technology” in the context of the information-measuring system “Smart house” are reviewed.**

Keywords - |measurement; practice-oriented work; smart house

I. INTRODUCTION

The first level students (bachelor) learn the basic of electronic devices (measuring devices, which perform simple functions) design and production. For example, there are direct measurements of physical quantities. The created device should involve system properties, i.e. it is possible to connect with other devices in the system. Device performance results should be represented in the standard form: the analog form (current 4.0-20.0 mA, a voltage of 0.0-10V), the discrete (code) form.

An example of the device measuring channel structure is shown in Fig.1

Students develop channels for measuring temperature, humidity, light, motion of object, motion of air, gas etc. Measurements are parameters of comfortable and safe indoor climate control. Each device and its implementation are result of BS graduation thesis.

The second level students (masters) are combined into teams and create a multi-channel system model of "Smart house".

The system provides the input of control results, analysis and acceptance of operating decisions (effects) for the respective actuators (fan, lighting, heating, drive, vents, etc.). Students develop algorithms and programs to enter monitoring results, results analysis, which depends on the physics of the parameter, control. In addition, students create operator panel which provides system operation control and diagnostic information output (mimic display of testing results, analysis, and management of emergency situations, security information, etc.).

Block diagram of the system is shown in Fig.2.

II. SENSORS AND CHANNELS DESCRIPTION

The model of a small apartment room with combined bathroom, kitchen, bedroom, living room and hall was analyzed in the described development. Each of these rooms has its own characteristics of microclimate.

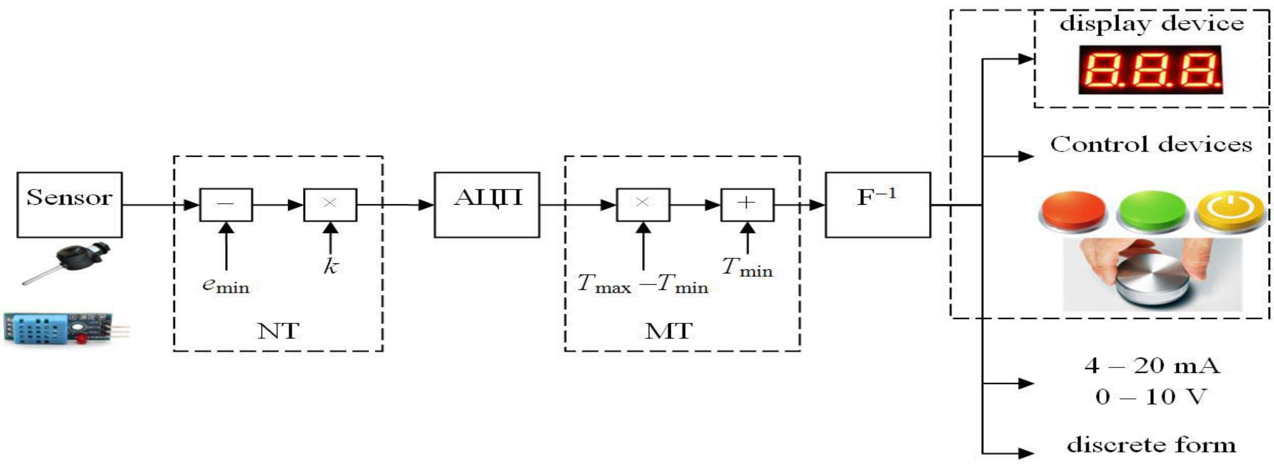

Fig. 1. Measuring channel structure

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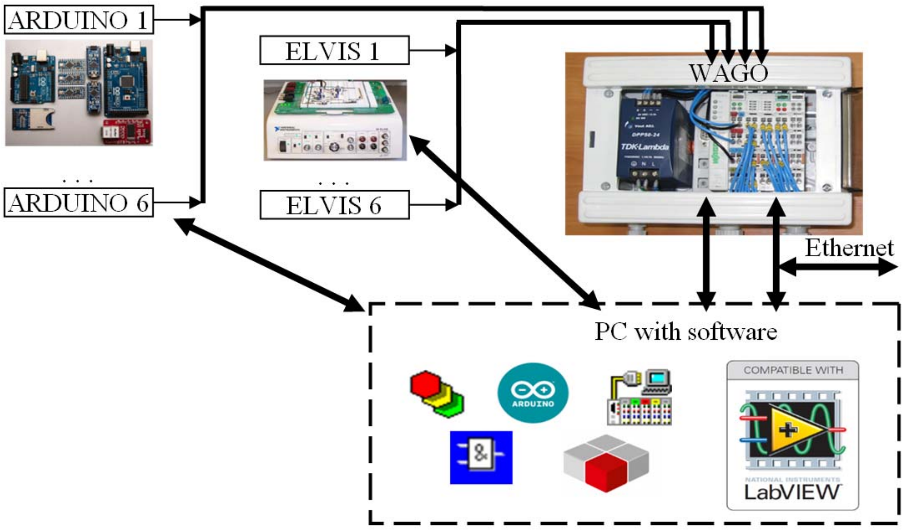

Fig. 2. Structural diagram of the system

The hall is equipped with an infrared sensor (D203B), when object appears in the field of view of the sensor, signal is applied to the microcontroller through the control system switches on the lighting (Fig. 3). Lighting is simulated by the switching on the diode.

In the room where always increased the heat and moisture, and these condition allow for propagation mold and fungus, is bathroom. A bathroom is a room with increased temperature and moisture that conduce mold and fungus.

They start to appear under the bathroom, under the sink or behind the toilet, i.e. all hard-to-reach areas. The daily volume of excess moisture reaches 10 liters per day (washing, bathing, showering, etc.) in the bathroom. Condensation, moisture, dampness, mold and fungus begin to destroy the house, and impair one's health of the house inhabitants. Therefore, the ventilation system should be installed definitely in this room.

The temperature and humidity sensor DHT11 (figure 4) was installed For a comfortable stay in the bathroom. DHT11 consists of two parts: a capacitive humidity sensor and a thermistor. A simple chip for the analog signal to the digital signal conversion is maintained in the body of the sensor. It is easy to obtain a digital signal in the output. Any controller can be used, not necessarily an Arduino. The sensor has only one digital output. Requests to the sensor can be sent no more than once per second. There are two types of sensor. They look the same, but the main difference is their performance.

Fig. 3. Infrared sensor (D203B)

Fig. 4. Temperature and humidity sensor HT11

There is a large number of sensors to read the gas concentration in the air. MQ-2 was chosen for the model design. This is the most common and inexpensive sensor. Furthermore, it is simple to operate. Sensor MQ-2 (Fig. 5) is sensitive to the smoke and flammable gases such as liquefied natural gas, butane, propane, methane, alcohol and hydrogen. the internal resistance of the sensor varies Depending on the gas level in the atmosphere. MQ-2 has an analog output, so the output voltage changes are proportional to the gas level in the environment. The module sensor has a built-in potentiometer which adjusts the sensitivity of the sensor depending on the required accuracy of gas level registration. If the gas concentration exceed beyond the allowable level, a sound signal emits using a miniature speaker (Fig. 6). The allowable amount of CO2 in the air of accommodation is stated in [1].

Fig. 5. Sensor MQ-2

Fig. 6. Miniature speaker

To create automatic lighting in the "Smart house" was used the photoresistor gl5528. A photoresistor is a semiconductor resistor (figure 7), which electrical resistance varies depending on its illumination. A photoresistor is a semiconductor radioelement, which has its resistance dependent on the illumination of sunlight.

Measurement of temperature is made using a digital temperature meter DS18B20 (Fig. 8), which is able to convert 9 - 12 bits and has a function of alarm signal of the temperature control. The control parameters can be set by the user and stored in the nonvolatile memory of the sensor. The DS18B20 communicates with the microcontroller via single wire connection using a Protocol of 1-Wire interface. The sensor power can be obtained directly from the data line, without using an external source.

Fig. 7. Photoresistor

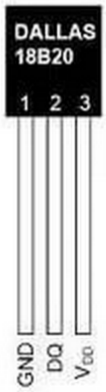

Fig. 8. digital temperature meter DS18B20

The sensor power supply comes from the energy stored on the parasitic capacitance In this mode. All measurements are displayed on two-line LCD display 1602A (figure 9).

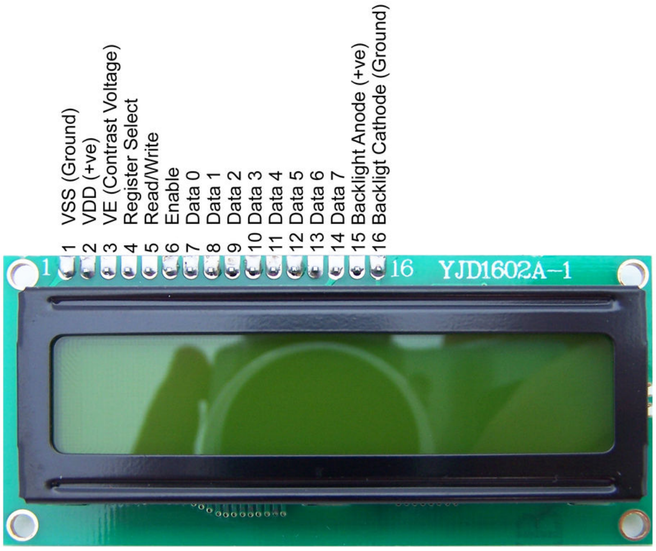

Fig. 9. LCD display

The assembled layout of the room with installed sensors is shown in Fig. 10.

1602A

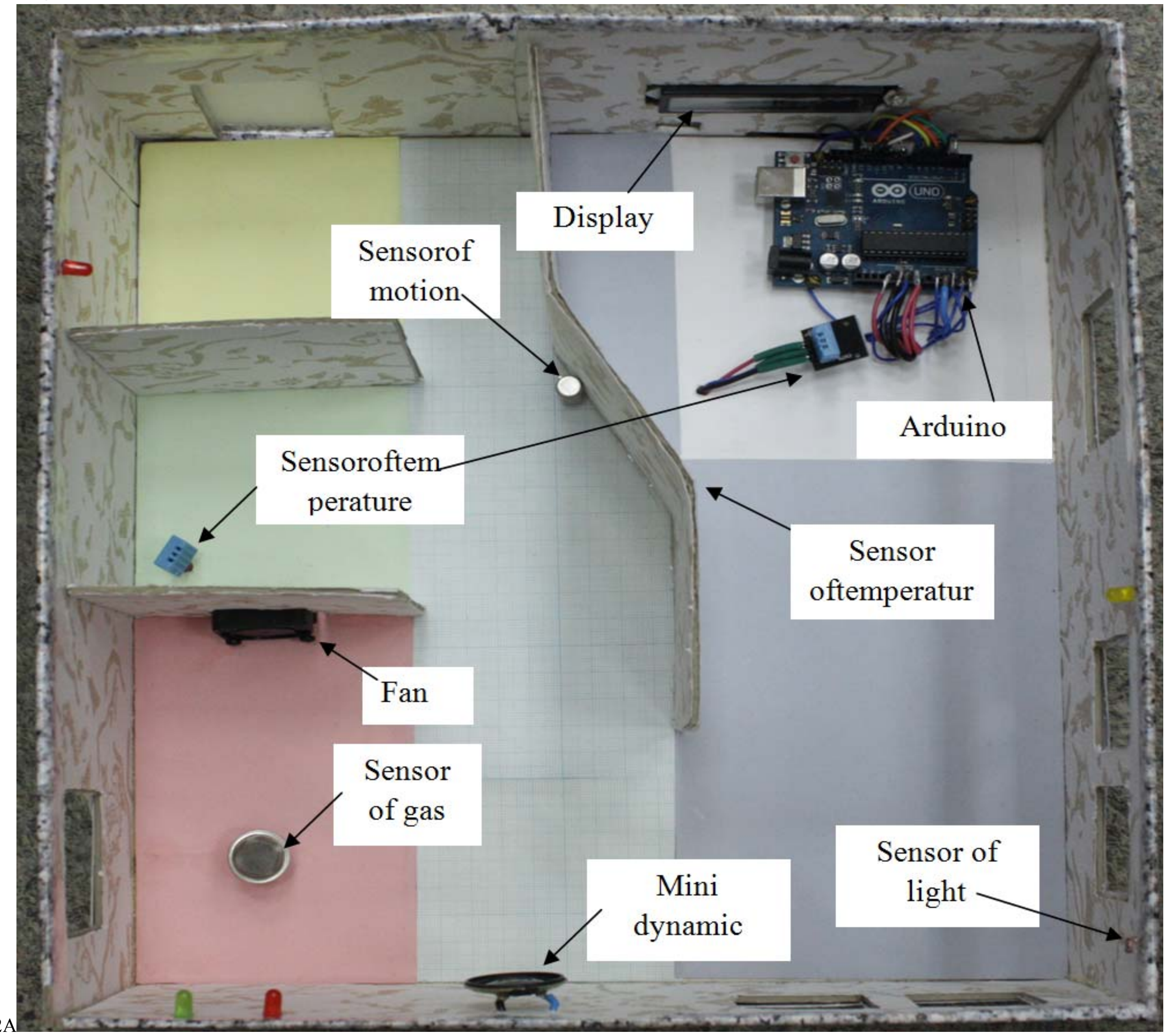

Fig. 10. The model of the room with installed sensors

Students should develop algorithms for sensor call sequence control, algorithms for decision-making. In addition, they have to implement the developed algorithms on a microcontroller Arduino Uno. Parameters described in [1] must be considered while set up of acceptable values is made. Two mode light control (day and night time with real time reference) should be developed in the room.

The report must contain block diagram of the developed algorithm and its description, fragments of program code with comments, examples of implementation of the algorithm.

III. CONCLUSIONS

To sum up, the created hardware-software and organizational-methodical base ensure the effective implementation of ideas comprehensive practice-oriented training using the example of the model of the information-measuring and control system "Smart house".

REFERENCES

[1] GOST 30494-2011 Residential and public buildings. Microclimate parameters for indoor enclosures