**1 Purpose of development**

**1.1 Functional purpose**

The software and hardware complex "SCANGAS" is designed for timely detection of dangerous gases in the air and signaling about it:

* detection of hazardous gas molecules in the air;
* alarm system for exceeding the threshold value of the content of dangerous gases;
* transfer of data to the server of the remote monitoring system.

**1.2 Operational purpose**

The software and hardware complex "SCANGAS" can be used by enterprises of the mining and chemical industries, as well as enterprises that have a risk of releasing hazardous gases.

**2 Hardware and software requirements**

This complex consists of 2 parts:

* hardware
* software version.

The hardware is implemented in the form of a device that allows measuring the content of dangerous gases in the air and transmitting it for further processing.

The software part is implemented as a set of commands that organize the correct operation of the hardware

**2.1 Requirements for functional characteristics**

**2.1.1 Hardware performance requirements**

The hardware part of this complex should perform the following functions:

* removing the signal from the gas sensor;
* digitization of the signal.
* ensuring the operation of the software part.

**2.1.2 Requirements for the functional characteristics of the software part**

The software part of this complex should perform the following functions:

* synchronization with the hardware.
* generating and sending commands to the device.
* receiving a digitized signal from the sensor.
* preparing data for transmission over the network.
* data transmission over the network.

**2.2 Reliability requirements**

For reliable operation of the hardware, it is necessary to provide protection of system elements from overvoltage.

For the software part to function reliably, the following exceptions must be handled:

* error syncing with the device.
* error connecting to the device.
* error when reading the signal from the device.
* error connecting to the server.

**2.3 Operating conditions**

A specially trained user is not required to operate the software and hardware complex.

**2.4. Information and Software compatibility requirements**

To develop this hardware and software package, you must have the following components:

* for hardware development - Arduino UNO, Arduino Ethernet Shield, MQ-2 Gas Sensor
* for software development - Arduino IDE

To develop the software part, you must have a Windows 7 or higher operating system.

**2.5. Requirements for the composition and parameters of technical equipment**

Minimum system requirements for software development tools:

* 1 GHz processor.
* 1 GB (for a 32-bit processor) or 2 GB (for a 64-bit processor) of RAM.
* 16 GB (for a 32-bit system) or 20 GB (for a 64-bit system) of disk space.
* A graphics device with DirectX 11 support and a minimum amount of 512 MB of video memory.
* SVGA monitor that supports a resolution of 800\*600 or higher.
* a «mouse» and keyboard manipulator.

**3 Hardware and Software User's Guide**

The software and hardware complex consists of 2 parts: hardware and software. Let's first consider the user's interaction with the hardware, and then with the software.

User interaction with the hardware includes:

* connecting all hardware components to each other.
* providing the Arduino board with power;
* providing a network connection.

Connecting an Arduino Uno to an Ethernet Shield expansion board consists of putting two boards on top of each other (Figure 1). All Arduino Uno ports are duplicated on the Ethernet Shield board. Data is exchanged between devices via the ICSP connector.



Figure 1 - Connecting an Ethernet Shield to an Arduino Uno.

The MQ-2 sensor is connected to the Arduino board using special wires (jumpers). The sensor pins are connected to the corresponding pins on the board. The connection of the board pins is shown in Table 1.

Table 1-MQ-2 and Arduino Uno pin connections

|  |  |
| --- | --- |
| Sensor Pin MQ-2 | Arduino Uno |
| Board Pin GND | GND |
| VCC | 5V |
| A0 | A0 |

The Arduino board can be powered using a USB cable from a PC or other power source, or via the Arduino power connector using various batteries, such as a crown, as a power source.

To connect the card to the network, you must connect an RJ45 network cable to the RJ45S connector of the Ethernet Shield card.



Figure 2- Connecting to an Ethernet Shield.

The software part consists of two components:

* firmware or sketch for Arduino;
* php script for interacting with MySQL.

To configure the system, connect the Arduino board to the PC via the USB port. Next, you need to install the Arduino IDE utility to edit the sketch and write it to the board.

To change the delay time between sending data to the server, the MAC address, and the address of the server to connect to, you must replace the current data with the required data. You must also specify the port for connecting to the server.



Figure 3- Editable sketch variables.

To configure the connection, you need to change the variables for connecting to MySQL to the required ones.



Figure 4- Editable php script variables.

To select the required table, you need to correct the SQL query.



Figure 5-SQLquery