Information-measuring system for life comfort evaluation on the basis of environmental monitoring data

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Abstract. The system of life evaluation, combining an objective component (indicators of water quality, morbidity) and subjective (the degree of satisfaction of residents with water quality) was developed. The system of life comfort includes information on people morbidity and the main consumed water parameters that affect the satisfaction of water resources and health. Such system units as «Input Interface» and «User Interface» have been developed in MS Access and are presented in the paper. In addition system includes geographic information system that allows visualizing, analyzing and predicting the state of the object. The main features of the system are shown and recommendations for its application are offered.

1. Introduction
To evaluate the life comfort index, it is necessary to understand that the ecological quality of the environment is the ability to ensure the functioning of ecological systems, comfort of human life and preservation of the physical and geographical basis of territorial natural resource complexes [1-5]. In other words, in this case, it can be interpreted as a direct linear relationship between the quality of water resources and the comfort of living.

If the above statement is accepted, the evaluation of the comfort level associated with the evaluation of the medium toxicity is obtained by the biotesting method or by a comprehensive assessment of the contamination extent of surface water by hydrochemical indicators. Therefore, it will be some integral index, directly dependent on the toxicity index or water pollution index.

2. System synthesis
Figure 1 shows the scheme of the life comfort evaluation system respectively to data of the water resources quality. It consists of software modules that are interconnected and united by a single interface.

System requires database [6] which involves primary information, for example, such as maximum permissible concentration (MPC), calculation of water pollution index (WPI), calculation of life quality, toxicity category, questionnaire survey, etc.

The evaluation of comfort will be calculated as the average value of the normalized indexes of water quality, its toxicity, level of morbidity and the results of the survey of the population on satisfaction with water resources quality.
3. Software and user interface

The data is collected through the input interface (Figure 2) constructed as user interface on the base of MS Access. Data input is possible both directly from the input interface and from MS Excel file (table structure). In addition the data input can be carried out in definitely generated table according to the sample. For this simply click on “Open in MS Excel” button and data will be transferred to the database, where it can accumulate and store until need to the other blocks.

The main in scheme is data processing and decision-making unit that analyzes information, calculates WPI, normalizes indicators and calculates the life comfort index, which will be the average value of all normalized components, as well as makes decisions about new data transfer to automatic notification unit about flash shift in indicators. That is, this unit performs primary processing, basic calculation and further transfer the information either to database or user interface.

The information about organoleptic, hydrochemical indicators, data on water toxicity, data on morbidity and the results of the survey of the population from the database arrives to the unit of data processing and decision-making. This type of information will arrive continuously, as these units are responsible for monitoring, the purpose of which is constantly monitoring and record changes in indicators.

![Figure 2. Input data interface](image-url)

The unit "Questionnaire survey data" contains personal data collected directly from people living in the area of study. Since the authors study the life comfort, it is advisable to take into account the subjective component, the feeling and satisfaction of each person with the quality of water resources.

The block of automatic notification of flash shift in indicators performs the function of comparison of incoming information with stored information in the database. In case of a sharp deviation of the new
values from the previous indicators, the interaction interface displays an alert to warn of an unusual situation, which, for example, may indicate an environmental disaster.

User interface (Figure 3) is represented by window in which the user can make samples and view the data of interest on the existing indicators, criteria, time period, area and sampling point, request the dynamics of parameter changes, build graphs, go to the geographic information system (GIS) MapInfo for data visualization.

Figure 3 shows the user interface, in which a sample of the region "Taganrog" indicator "Morbidity" criterion "Respiratory system" in the period from 10.02.2010 to 10.10.2014 is presented. Plotting was carried out when selecting the switches "Conc/Morbid" and "By months", which means in this case on the vertical axis – percentage of people with respiratory disease, and on the horizontal – the date of diseases registration (in months).

![Life comfort evaluation system](image)

**Figure 3.** User interface. Sample on morbidity

Figure 4 shows the user interface in which the sample for the region "Taganrog" indicator "Hydrochemical index" criterion "Petroleum products" in the period from 17.05.2011 to 09.12.2011, plotting was carried out when selecting the switches "Conc/Morbid" and "By mouth / points", which means concentration of petroleum products on the vertical axis, and sampling points – on horizontal.

Thus, choosing the necessary parameters and activating the necessary switches, it is possible to consider the different dynamics of the selected indicators.

In the interaction interface there is also a "Comparison" item (Figure 5), choosing which, it is possible to compare data for two periods or seasons, which allows observing and analyzing the trend of indicators over two periods of time on the same chart. Point "Forecast" allows on the basis of available data providing forecast on further development events.
Figure 4. User interface. Sample on mouth

Figure 5. User interface. Comparison of WPI on points over two periods

Figure 5 presents the user interface in which the comparison of WPI in mouth 245 (water sampling point) for two periods: from 01.01.2010 to 31.12.2013 and from 01.01.2014 to 31.12.2016 is shown. The plotting was carried out when selecting the switches "WPI" and "By mouth / points", which means on the vertical axis – water pollution index, and on the horizontal – sampling points.
The button "Caution" is inactive as long as the unit of automatic alerts about sudden changes of the indicators will detect anomalous values. The active button is highlighted in red. When it is clicked on it, information about indicators that have exceeded the average data and can cause the risk of environmental disaster or epidemic is shown.

4. Conclusion
The developed system allows analyzing the data of environmental monitoring, sanitary and epidemiological situation and questionnaires in order to assess the life comfort level, which will allow identifying and predicting in time development of negative processes affecting the quality of water and human health. As a result, due to obtained data, it will be possible to develop and implement measures to prevent the negative consequences of such processes.

In addition, the analysis of the survey data will allow creating a general portrait of satisfaction with the life quality from the point of view of individuals and assessing the level of "public mood", which in turn affects the performance of people and their emotional state.

Thus, the system of assessing the life comfort of population can be an auxiliary tool for assessing the effectiveness of management at the municipal level and determine the social development of the region, which is a balanced development of all spheres of life.

The developed system for assessing the comfort of life is based on the parameters of consumed water, but it is possible to expand the analyzed data. Information on the quality of land (soil) and air quality can be included in the system. This will allow monitoring of life comfort on environmental components.

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