Development of the device for water monitoring of the reservoirs

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Water: from H₂O to IT

Introduction

A natural reservoir is a multilevel and autonomous to a considerable degree ecosystem, which includes dozens and hundreds of species of living organisms, which are closely related to one another. It is especially important to mention that such water reservoirs are a kind of self-balancing system. Any change in the environment makes the components of this system react in such a way so that the system could be maximally restored to its original state. Moreover, only natural aquatic ecosystems can sustain the existence of outstanding species of the living organisms listed in the Red Data Book.

The object of research
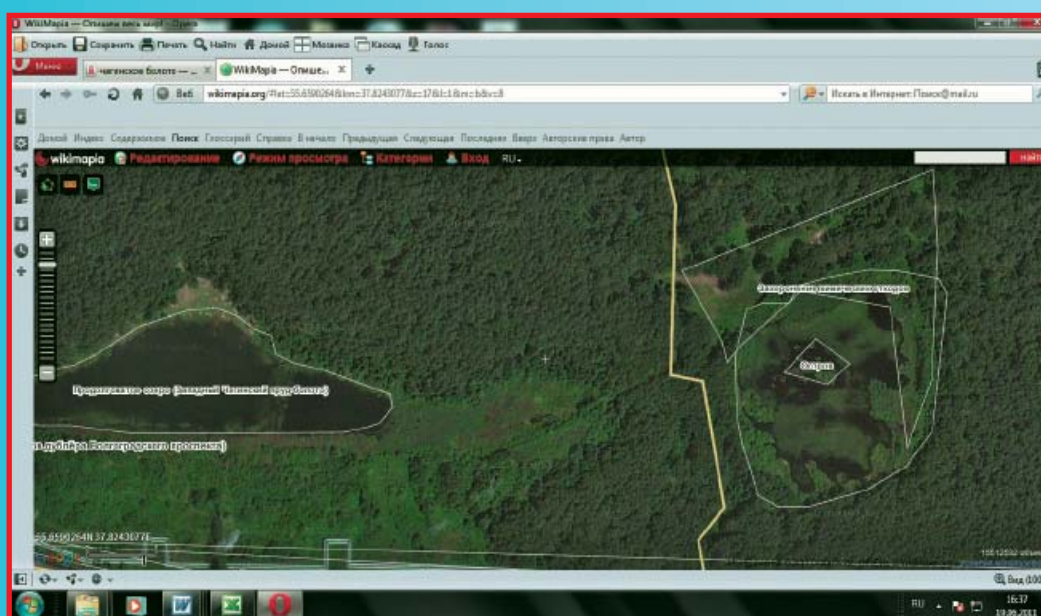
The main reasons for the reservoir degradation are uncontrolled pollution and excessive recreational loading. Water reservoirs become disposal sites for household rubbish and industrial waste.

However, only major water reservoirs are monitored and most small rivers, lakes and ponds are not under monitoring. Meanwhile, the value of small water reservoirs is exceptionally high. The disappearance of such a water reservoir greatly impoverishes the biodiversity of any natural complex.

Currently, the State doesn't have funds to arrange an effective monitoring system of small water reservoirs. There is no routine small water reservoir monitoring within the framework of State monitoring. It is these 'blank spots' which can and must serve as objects of public environmental monitoring. Moscow schools are fitted with sets of research equipment (laboratory 'Archimedes', 'ROBOLAB'), which can be used in order to arrange the system of public school monitoring of small water reservoirs, which are not on the list of the State environmental monitoring.

The study water reservoirs are small lakes –the Round Lake and the Mishkin Pond – are situated in the south-eastern part of SPNA 'Kuzminki-Lyublino'. The water reservoirs are used by citizens for relaxation near the water and unprofessional fishing.

The Round Lake: the diameter is 190m, the square is 2ha, it has little islands called floating bogs. There are few convenient ways to water, the watersides resemble bogs of an intermediate type. The bottom is silty. The lake is of natural origin.

The Mishkin Pond has a narrowish shape- 400m to the west, its width is approximately 130m, its square is 2ha. There is a power transmission line along the south bank, then there is a plant of special mounting production, there is a sandy beach on the north bank, the south bank and the south-eastern banks are swampy. The pond is of artificial origin. The forest area around the water reservoirs has mainly middle-aged birches and pines.

The goal and stages of the project

The goal of the project is to develop a device for primary examination of the state of small water reservoirs.

The stages of the project
1. To design an autonomous automatic laboratory (AAL) for primary examination of small water reservoirs;
2. To conduct field testing of the autonomous automatic laboratory;
3. To evaluate some physical and chemical parameters, which reflect the ecological state of the study water reservoirs;
4. To assess the ecological state of the study water reservoirs.
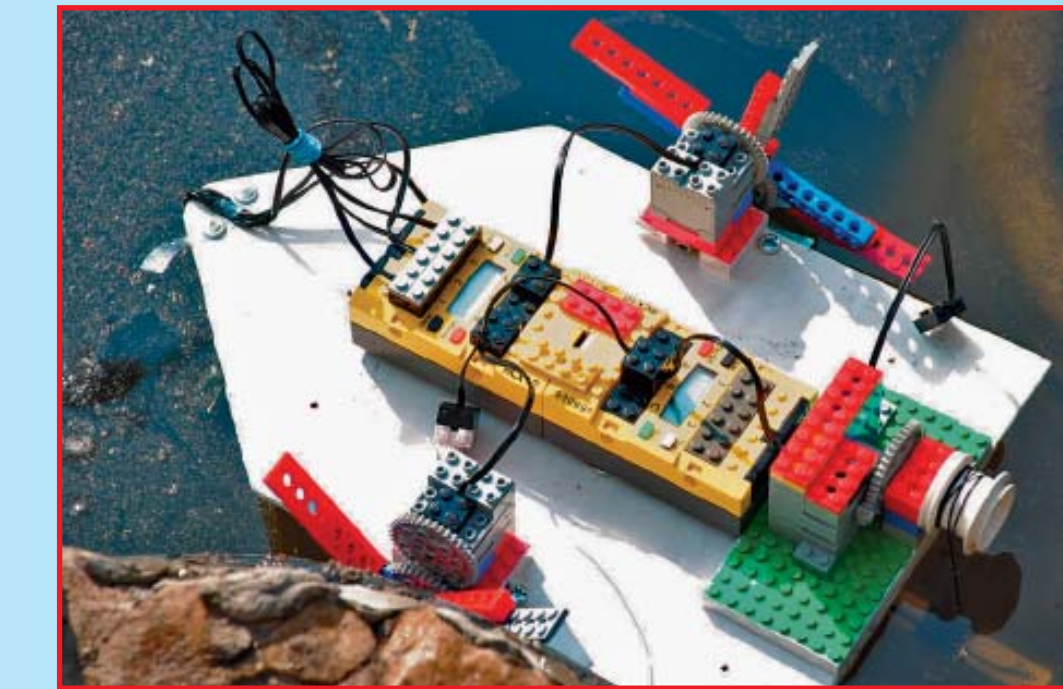
Developing of the device

As a device of fixation measurement parameters we used school digital laboratory 'Archimedes', which includes tablet PC NOVA 5000 with a software and a set of measure sensors, while designing an autonomous automatic laboratory.
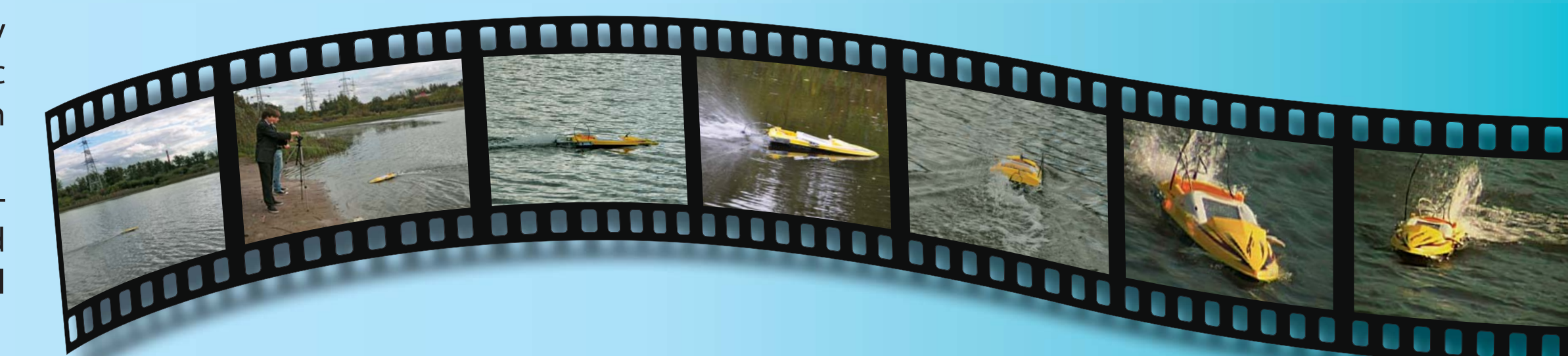
The model of the speed boat 'AVANT-COURIER' was upgraded by us:
1. Parts of both boards were deleted and holes for the sensors were made.
2. The platform for the sensors was attached to the speed boat with the help of curved metal plates.
3. The sensors on the stern of the speed boat were fixed.
4. PC NOVA 5000 was fixed in the speed boat hull.
5. The sensors to the PC were connected

Tab. 1. The results obtained using AAL (mean sample value).

The interval of measurement, 5 s	Dissolved Oxygen mc (mgО2/l)		pH		Temperature (°C)	
	The Round Lake	The Mishkin Pond	The Round Lake	The Mishkin Pond	The Round Lake	The Mishkin Pond
1	7.45	8.41	6.51	8.11	18.88	18.12
2	7.55	8.42	6.52	8.12	18.89	18.17
3	7.54	8.41	6.54	8.11	18.91	18.18
4	7.50	8.41	6.55	8.10	18.89	18.20
5	7.52	8.39	6.59	8.12	18.87	18.20
6	7.52	8.42	6.54	8.13	18.87	18.21
7	7.52	8.41	6.54	8.14	18.88	18.19
Mean Value	7.51	8.41	6.54	8.12	18.88	18.18

Note: The tab contains arithmetic mean values from total amount of values obtained.

Tab. 2. The results of organoleptical and chemical water analyses (mean sample value).

Measured indicators	Maximum Allowable Matter Concentration	The Round Lake	The Mishkin Pond
Chemical analysis			
pH	6,5-8,5	6,5	8
Carbonate hardness (mg-equiv/l)	10	6	6
Total hardness (mg-equiv/l)	7,0	4	7
Nitrites (mg/l)	3,0	0,5	0,5
Nitrates (mg/l)	45	10	10
Phosphates (microgram/l)	3,5	0	0,3
NH4/NH3 (mg/l)	2,0	0	0
Total iron (mg/l)	0,3	0	0
Cu (mg/l)	1	0	0
Dissolved oxygen (mg O2/l)	not below 4	7,5	8,5
Organoleptical analysis			
Colour		yellowish, brownish and yellow	yellowish
Odour (grades)	2	Putrefactive, 3	Putrefactive, 3
Suspended particles		present	Very few

Note: The tab contains arithmetic mean values from total amount of values obtained.

Conclusions:

1. The device designed for monitoring of the state of water reservoirs on the platform shoe of the radio-controlled speed boat, model 'AVANT-COURIER', and the stateful device of the tablet PC NOVA 5000 has proved its value to the full. The device allows to collect primary data about a water reservoir easily, quickly and accurately and it makes it possible to shape a follow-up plan for research.
2. Further research via the bioidentification method and the physical and chemical water analyses has confirmed tentative assumptions about the state of the water reservoirs.
3. 'The Mishkin Pond' and 'The Round Lake' are classified as moderately polluted (quality class 3) water reservoirs of a mesotrophic type, and that makes it possible to use them for swimming and fishing.
4. We can recommend the device of an autonomous automatic laboratory designed by us for school public monitoring of small water reservoirs in Moscow.