UKRAINE TEAM

United Nations Educational, Scientific and Cultural Organization

Junior Academy of Sciences of Ukraine

Vladyslav Yevlan

MICROCLIMATE MONITORING IN CLASSROOMS OF EDUCATIONAL INSTITUTIONS USING MODERN DIGITAL DEVICES

INTRODUCTION

Optimal microclimate is one of the necessary conditions for normal life and well-being of people. Effective control of microclimate parameters in educational premises improves work capacity and health of students (or employees at work), due to maintenance of sanitary standards in classrooms. This is especially important during the coronavirus disease pandemic.

The relationship with the global goals of the UN: “good health and well-being”, “quality education”, “clean water and sanitation”.

Used methodology: elementary-theoretical analysis, experiment, measurement, observation, comparison, empirical analysis, inductive reasoning.

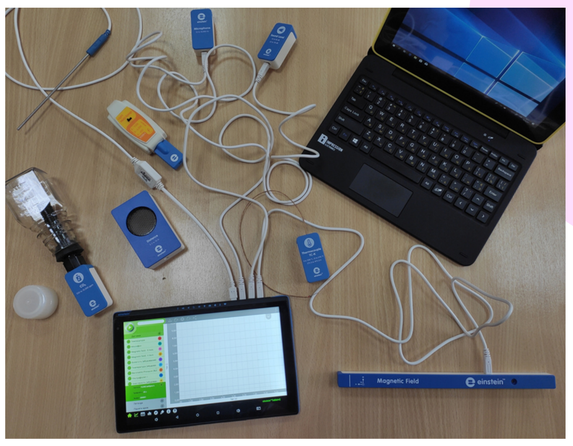

Fig. 1. Einstein Tablet+2 digital laboratory

TASKS

- to justify the importance of microclimate monitoring in educational institutions;
- using the Einstein Tablet+2 digital laboratory (see Fig. 1), conduct monitoring of microclimate in the classrooms of my school and compare results with standards;
- to show the expediency of using digital laboratories for research purposes;
- to propose existing methods of improvement of microclimatic conditions;
- to invent a system that may be useful and the most expedient for the goal of continuous microclimate control and improvement in an educational institution.

HYPOTHESIS

Bad feeling and poor productivity of students is the cosequence of bad microclimatic conditions in educational institutions.

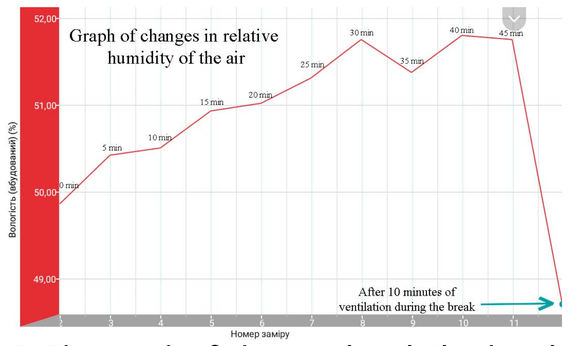

Fig. 3. The graph of changes in relative humidity of the air (in %) during the lesson without ventilation; the last point of graph is the value of relative humidity after the 10 minute break

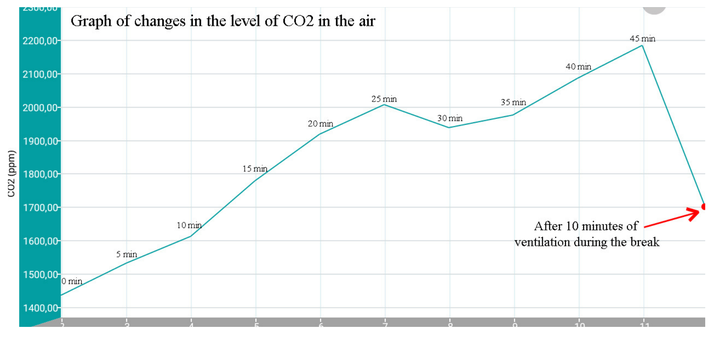

Fig. 2. The graph of changes in CO2 level in the air (in ppm) during the lesson without ventilation; the last point of graph is the value of CO2 level after the 10 minute break

RESEARCH PROCESS

I have monitored the microclimate of my school using Einstein Tablet+2 digital laboratory. I recorded the results in the Table 1 and compared them with the normative values from the sanitary regulations. In addition, I conducted measurements of CO2 and relative humidity during the lesson. After the second lesson in a row, the level of CO2 exceeded the normative values by 2 times. Moreover, ventilation during the 10-minute break is not effective enough to restore the CO2 level to normal (see Fig. 2), but effective for drying the room air (see Fig. 3).

As you can see, educational institutions need means to improve microclimatic conditions. And, taking into account the fact that the values of all the studied parameters depend on many external factors, it seems appropriate to conduct continuous monitoring of these parameters.

Classroom №	Temperature (°C)	Humidity (%)	Illumination (lx)		Floor area (m^2)	Area of all windows in the classroom (m^2)	LF
			natural	mixed			
6	14.4	57,8	290	476	44,84	7,8	0,174
7	15	55,8	270	524	27,36	5,2	0,190
8	15,4	64,2	110	420	48,38	7,8	0,161
9	16,6	59,8	150	440	47,2	7,8	0,165
10	18,4	61,8	236	588	28,5	4,3	0,151
Lib	18	58	224	790	43,2	7,8	0,18
15	17,8	61,7	406	626	47,4	7,8	0,160
18	18	58,4	340	474	84,6	7,8	0,160
19	16,5	62	195	430	47,4	7,8	0,164
20	16,7	48,3	342	522	46,1	7,8	0,169
21	18	59,3	295	512	46,1	7,8	0,169
22	17	55,9	408	564	45,6	7,8	0,171
23	18,1	64	570	706	38,5	7,8	0,202
24	19	55,7	1340	1662	38,35	7,8	0,202

Table 1. (values which fall within the normative interval are green, and which did not fall are red)

SOLUTION

That is why I decided to create such a system, which would receive the values of the microclimate parameters in real-time during the working day in each room of a building and automatically normalize them using unique devices.

This system can normalize temperature, humidity, CO2 level, and illumination; and filter dust, bacteria, and generally PM2.5 particles. In addition, the panel of sensors can transmit received data via Wi-Fi to the main computer. There the data is saved and processed. I called this system “The system of centralized control and automatic improvement of microclimate”, abbreviated as SCCAIM (see Fig. 4).

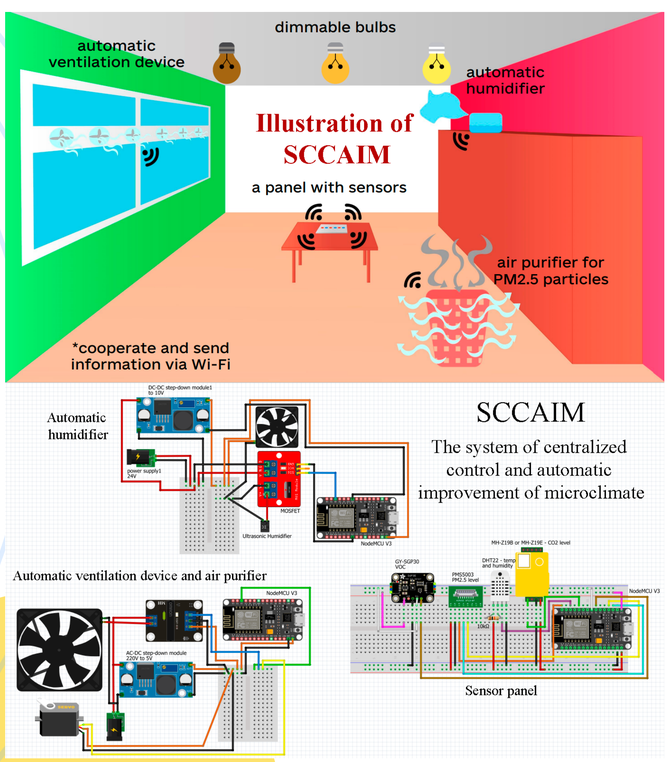

Fig. 4. Illustration of SCCAIM and its circuit based on ESP8266 microcontroller

CONCLUSIONS

I experimentally made sure that the microclimate of my school is not ideal (this could mean that some part of other educational institutions more or less has the same problem). Thus, schools need means to improve its microclimate control system.

In addition, in the full-report, I investigated in detail the possible consequences of the violation of microclimate standards. Besides SCCAIM, I have suggested other microclimate improvement devices, but most of them can be quite expensive to install in a school. It will be even more expensive to assemble the entire set of devices for controlling all the main parameters of the microclimate.

So going forward I plan to develop the SCCAIM idea and create a prototype. Then conduct monitoring with it for practical proof of the appropriateness and effectiveness of its use.

If educational institutions take care of microclimatic conditions, they will achieve a significant increase in working capacity and student attendance, thanks to a decrease in incidence. This will clearly increase the number and quality of skilled workers worldwide.