Environmental monitoring of workplace lighting using optical Internet

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Abstract. The article shows the need for efficient use of electric energy in order to preserve the resources and environmental health of the planet. The necessity of the modernization of existing systems controlling the ambient light in the area of jobs solution to the problems of ecology eyes. The method of control and adjustment of illumination of workplaces and zones where it, is necessary is offered. A control system using the optical Internet has been developed. The simulation of the system operation was carried out, the possible amounts of saving electric energy, natural resources and reducing the negative impact on the environment were determined.

1. Introduction
At present, more and more electrical energy is required to solve various problems of humanity [1-12]. An increase in its production leads to an increase in the negative impact on the ecology of the planet [11-23]. Also, the production of electricity requires the expenditure of a huge amount of resources, the additional extraction of which worsens the environmental situation in the world [1-4, 10, 11, 13-15, 24]. Therefore, solving the problems of efficient use of the generated electricity is a very urgent task for humanity, which affects several areas [13-15, 21, 24-26]. It should be noted that the transmission of large additional amounts of electricity creates a number of problems that affect human health. Especially related to the increase in the range of electromagnetic radiation [27-32].

One of the ways to reduce the cost of electricity is to reduce its lighting costs, especially in office and educational premises, where there is natural light in different time periods [33]. This problem is still very relevant - although there are a large number of systems for regulating the illumination of the room, they are aimed at controlling the illumination from the basic (artificial) lighting at some points in the room. In the vast majority of these systems do not take into account natural light sources, so if there is, for example, sunlight, there is excessive lighting of the room, which leads to unjustified energy costs. The analysis of the operation of such systems showed that the possibilities for their modernization do not correspond to the current development of requirements (reducing the level of electromagnetic radiation in the premises, etc.) [28-30, 34]. The development of new technologies and systems allows us to develop new and more effective solutions compared to those that were previously used.
2. Automatic room light monitoring system

Today, the premises are equipped with a large number of routers, and the number of users simultaneously connecting to a wireless network can reach several hundred. All this leads to a large congestion of the air space and can lead to distortion of the transmitted information. To effectively solve this problem, it is proposed to use an optical channel between the user and the receiving and transmitting device [34-39], which is placed on the ceiling and connects to the server. The second optical receiving and transmitting module is installed on the desktop and is connected to the routing system to which personal computers and laptops are connected. To ensure a comfortable and safe work of a person, first of all, it is necessary to maintain the light level set by the standards directly in the working area (for example, in the area where a personal computer is located). In our work, it is proposed to place sensors for light monitoring based on photodiodes [40-45] in close proximity to the optical channel receiving and transmitting device on the table, depending on the configuration of the optical Internet [34-39]. Fig. 1 shows a block diagram of the automatic lighting control system of workplaces integrated into the optical Internet.

![Figure 1. Scheme of the automatic illumination monitoring system using the optical Internet.](image)

The light sensor constantly registers data on the light intensity in the local area and transmits this information to the information processing unit developed by us. To save space, it can be built into the routing system. This block converts the received data into a packet and submits a request for sending. An important device in this case is a device for switching channels through which information is transmitted to the electro-optical modulator in the receiving and transmitting module of the optical channel, especially if the information is transmitted with spectral channel compaction. When receiving a request for sending, this device allocates a time interval during which information about the illumination is transmitted to the server via the optical channel. The server, having received data from all sensors, generates commands based on this information for the lighting control system, which changes the voltage on each lamp, thereby adjusting the level of illumination of the room to the level set by the standards. In addition, to reduce energy costs during operation of the system, would consider extra charging batteries optical communication system energy from solar cells placed in some areas of the desktop, and working from light lighting. The data is transmitted to the server at intervals of 20 seconds, since the weather conditions that provide lighting do not change instantly.

3. The simulation results of the system operation

Let's consider two scenarios: the first - the light sources work continuously and without changing the intensity of radiation throughout the working day, the second-the room uses an automatic monitoring system for the illumination of the room. The light sensors are located directly under the lighting...
devices so that if there is sunlight, it falls on one of the sensors, as shown in fig. 2. The second one gets about 30% of the sunlight.

![Diagram of sunlight and sensors](image)

**Figure 2.** Model for measuring illumination at a constant and changing value of the radiation intensity of light sources.

The duration of the working day in the offices is about 10 hours [26]. Illumination sufficient for comfortable and safe operation—approximately 400-500 lux. To maintain the desired light level, one lamp per hour will consume 20 watts. There are five lamps in one lighting device, so the lighting system consumes 200 watts. With continuous use of lighting devices during the entire working day, 2 kW. During the working week (6 days) - 12 kW.

When using an automatic light monitoring system, one of the lamps will not work at all, as it will be replaced by sunlight. Also, if we take into account that the intensity of sunlight on a cloudy day does not fall below 1000 lux, then even 30% of this value is enough to compensate for half of the required illumination. As a result, the cost of electrical energy of the second lamp is reduced by half. The total cost of electricity per week will be reduced by 10 kW.

4. Conclusion
The results of the simulation showed that our system will save electricity for a week, the production of which was spent 40 kg of coal. It should be noted that when burning this coal, more than 80 kg of carbon dioxide were released into the planet's atmosphere. Also, when burning 1 ton of coal, in addition to a huge amount of carbon dioxide, more than 200 kg of ash is released, some of which flies into the air. At the same time, the damage caused to the environment during the extraction of raw materials and its transportation was not taken into account.

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