Abstract

In the era of global climate change, the reduction of emissions and energy savings is of paramount importance. To mitigate the impact of buildings on energy consumption and the environment, in recent years, many experts have conducted research on energy consumption and published their findings. In 2021, building operations accounted for 30% of the world's final energy consumption and 27% of total emissions from the energy sector, of which 8% were direct emissions from buildings, and 19% were indirect emissions resulting from the production of electricity and heat consumed by buildings. Therefore, efforts should be directed towards improving energy efficiency, increasing the use of renewable energy, as well as saving energy and reducing CO_2 emissions.

Thanks to the functional capabilities of integrated control and automation systems, it is possible to manage energy efficiently, as well as create ergonomic working and living conditions. This paper presents proposed actions and solutions aimed at reducing the maintenance costs of an office building equipped with a Data Processing Center (DPC), improving functionality, and ensuring the safety of operation and the ergonomics of technical equipment.

The task carried out within the framework of the industrial doctorate was to propose an energy-saving solution and present a strategy for controlled energy consumption in an office building equipped with a Data Processing Center (DPC). It is known that energy consumption inside a building depends on many variables, such as weather, thermal insulation of the building's exterior, user behavior, and geographical location. Moreover, the electricity consumed by buildings is characterized by clear seasonal patterns and uncertainty. The work can be divided into two parts. The first part presents the theoretical issues related to building automation and control, discusses available building automation technologies and systems, and compares selected building automation systems used worldwide.

The second part of the paper presents detailed concepts and the implementation of two projects: a server room for the existing KS-133 building and a new CRON office building. The designed solutions were previously justified. The results of preliminary research conducted for the existing GLON office building were presented. The results were recorded thanks to the measurement system, which enabled the collection of data, including electrical parameters of heating and cooling systems for selected rooms along with environmental parameters. The designed solutions were verified using predictive models and a model based on classical control system analysis.

The result of this research was the proposal and introduction of improvements to the system to achieve energy savings. The final element presented in the paper was the design and implementation of a PV installation with an energy storage system. In the final chapter, a summary was made, the significance of the research was justified, and the achievement of the research objectives was confirmed.