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# SMART BUILDINGS TECHNOLOGIES − IMPLEMENTATION EXPERIENCE

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***Problem statement.*** Smart home technologies, often known as “intelligent homes” or “smart-home” are becoming increasingly common in the modern world.

Building automation systems (BAS) or Building management systems (BMS) are the basis of smart buildings. Network of sensors, controllers and devices are used in these systems to automate and optimize building operations, including heating, ventilation, and air conditioning (HVAC), lighting, security systems, etc.

The smart buildings technologies are used to increase energy efficiency, occupant comfort, environmental protection, to provide security, access control and also reduce operating costs.

The beginning of the use of smart buildings technologies can be considered the early of the 20th century, when thermostats began to be used for regulation of the indoor temperatures in buildings.

However, significant development of smart building technologies began in the 1980s due to the global energy crisis and the need to solve energy efficiency problems in the residential sector of the economy.

In the 1990s, with the introduction of new technologies such as sensors, automation, and computer systems that formed the centralized building management system (BMS), the concept of “smart” buildings significantly evolved. New technologies are already allowed to control various systems in the building, including heating, ventilation, air conditioning, and lighting.

Since the early 2000s, the number of devices for smart buildings has been rapidly increasing and uniting by in the concept of “Internet of Things” (IoT). IoT devices are basically smart devices that are connected to the Internet and are able to interact with other devices via the Internet. While the user can remote access to control the devices according to your needs.

***Purpose of the study.*** The aim of this work is to highlight the implementation experience elements of smart building technology in the execution of scientific research and scientific-technical projects at the Prydniprovska State Academy of Civil Engineering and Architecture. Additionally, the issues related to Internet of Things (IoT) technology will be reviewed.

***Main results.*** In the modern world, the majority of everyday tasks are simplified or automated, and this trend continues to grow with each passing year. Electronics and remote-control technologies got deeply integrate into the daily lives of contemporary individuals. The popularity of automated systems, such as “smart homes” is driven by people's desire for comfort and convenience. One such technology is the Internet of Things (IoT).

The Internet of Things (IoT) is a concept of a network that is consist of interconnected physical devices with embedded sensors, as well as software that enables the transmission and exchange of data between the physical world and computer systems automatically, using standard communication protocols. In addition to sensors, the network may include actuators embedded in physical objects and connected to each other through wired or wireless

networks. These interconnected devices have the ability to read, process, analyze data and the system can make decisions according to received data, and can eliminate the need for human intervention through the use of intelligent interfaces [1].

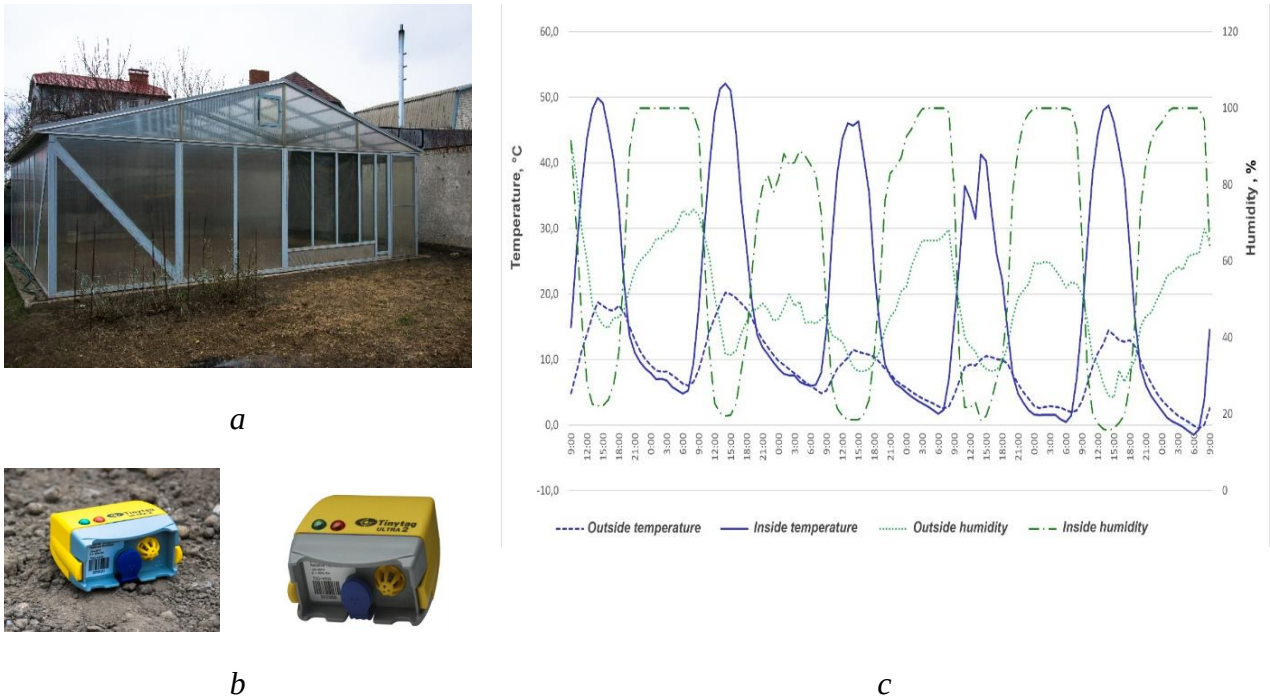
The main concept of IoT is the ability to connect various objects (things) that people use in everyday life, such as refrigerators, air conditioners, cars, etc. All these objects (things) must be equipped with built-in sensors that can process information from the surrounding environment, exchange it, and perform various actions based on the received information. An example of implementing such a concept is the “smart home” system. One of the directions of operation of such a system is monitoring and regulation of microclimate parameters in the premises of a building without human intervention.

The Internet of Things (IoT) has the potential to bring about significant changes in everyday life, providing ordinary users with an entirely new level of comfort. However, such smart systems have a both range advantages and disadvantages and dangers.

The advantages of IoT Technology are providing good automation and control between devices and machine interaction, the saving a lot of time and the saving money by reducing manual task and time, the increasing quality of life.

The disadvantages of IoT Technology are the lack of international standards for interoperability, they may become highly complex resulting in failure, IoT devices may get affected by privacy and security breach, reduced safety for users, reduced of the employment of manual tasks and job reductions, Internet of Things devices may take control of life in due course of time with increasing AI technology.

**The experience of implementing and using smart technologies in scientific projects of PSACEA**. A smart system for monitoring microclimate parameters was used to evaluate the efficiency of using thermal accumulators in the greenhouse heating system (Fig. 1).




*a* *b* *c*

*Fig. 1. Study of the efficiency of using heat accumulators in the greenhouse heating system: a) general view of the experimental greenhouse; b) Tinytag Ultra 2 data logger; c) experimental measurements of the temperature and humidity inside and outside the greenhouse*

The system consisted of digital sensors Tinytag Ultra 2 TGU-4500 to continuity control temperature and relative humidity indoor and outdoor of greenhouse during long time and software for data decryption [2].

Some elements of construction smart technologies have been implemented in PSACEA, namely: security elements − surveillance cameras both outside and inside the premises, elements of remote monitoring of heat consumption in the dormitories of the academy, management of the lighting of the facades and premises of the academy, monitoring of electricity generation of the solar power plant (Fig. 2).

The following smart building technologies have been realized in a private building in the village of Slobozhanske 14 Vyshneva str.: hybrid solar power plant with a capacity of 15 kW with electricity accumulators and monitoring of electricity generation; heat recovery ventilators; heated windows (Fig. 3).

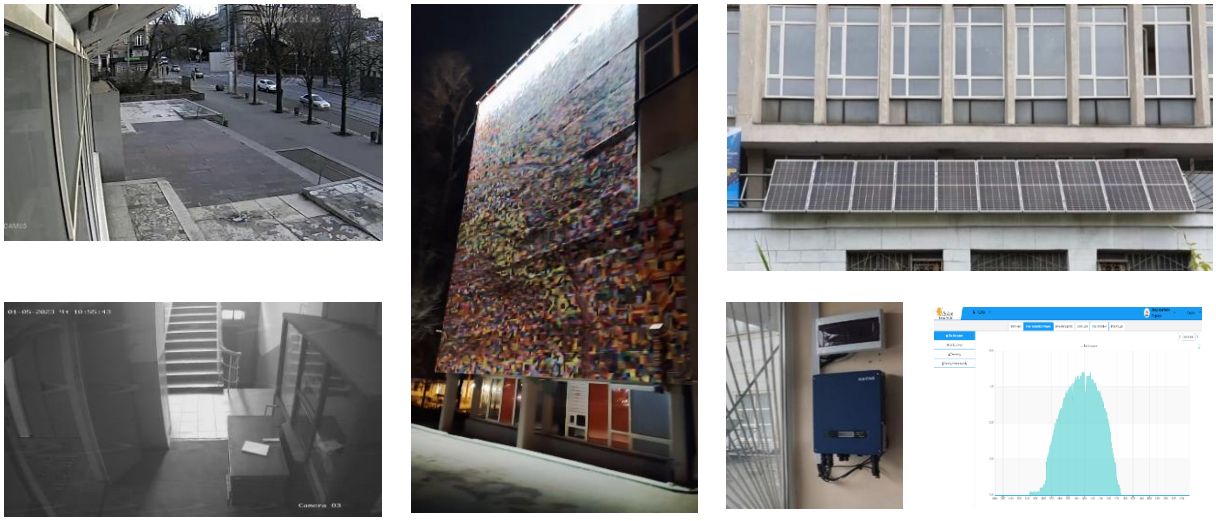


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*Fig. 2. Elements of smart technologies in PSACEA: a) security elements − surveillance cameras both outside and inside the premises; b) management of the lighting of the facades; c) monitoring of electricity generation of the solar power plant*

*a* *b* *c*

*Fig. 3. Elements of smart building technologies in a private house in the village of Slobozhanske: a) building facade with solar panels; b) solar system control panel; c) heat recovery ventilator*

In a first energy efficient building in Ukraine Optima House in the village Mykulichi near Kyiv the complex smart building technologies have been implemented, namely management of heating, ventilation, and air conditioning, lighting and security systems [3] (Fig. 4).

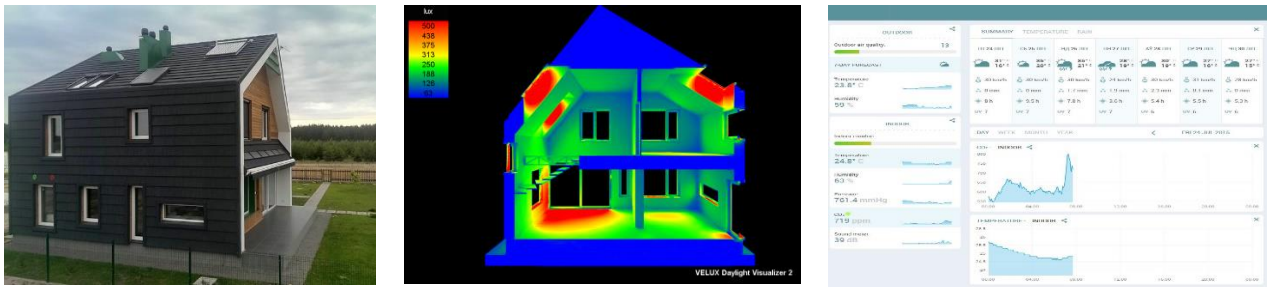

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*Fig. 4. Smart building technologies in Optima House: a) general view of the Optima-House building; b) daylight visualizer test; c) monitoring system of microclimate parameters*

The technical solution for a proactive management system of residential buildings has been developed and realized in the residential complex “Panorama” while to work under the international project PRECEPT.

The technical solutions are based on smart building technology and provides monitoring and management of thermal and electrical energy consumption, microclimate parameters (temperature and humidity), and air quality (carbon dioxide level) [4] (Fig. 5).

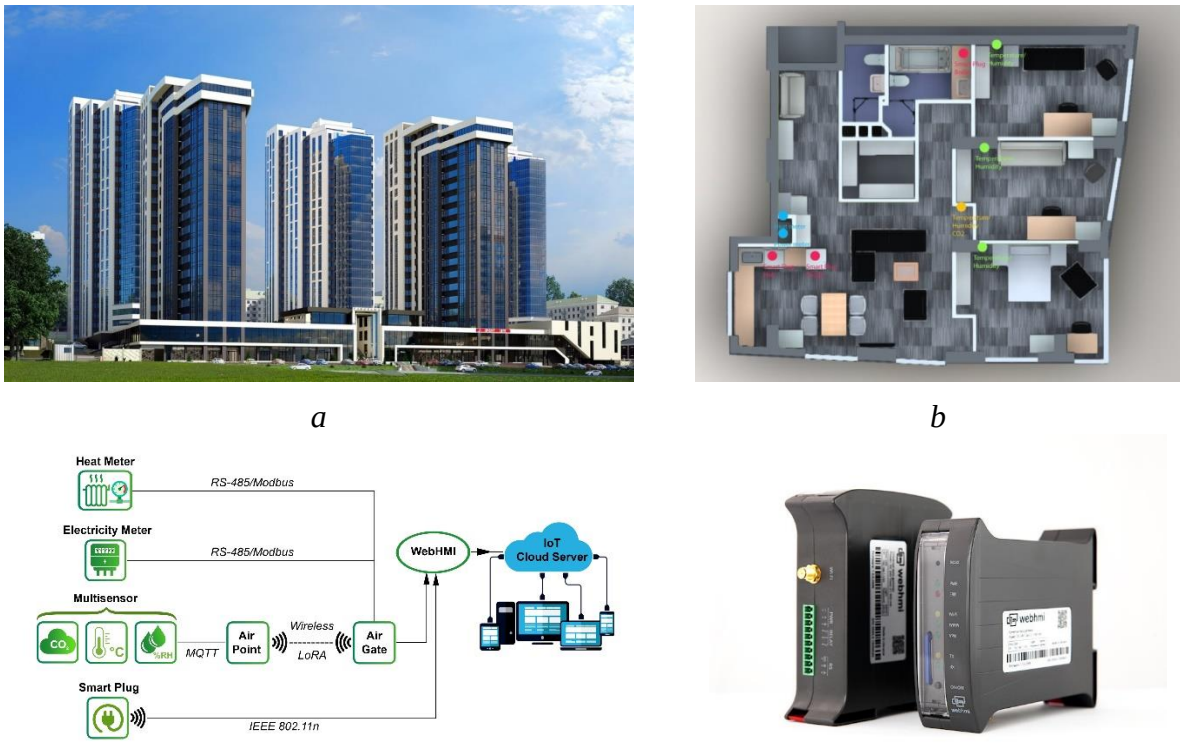


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*Fig. 5. Smart building technologies in residential complex Panorama: a) pilot object − Panorama residential complex; b) installation scheme of smart equipment in a typical apartment; c) Schematic diagram of a technical solution for a proactive management system for residential buildings; d) the controller WebHMI*

***Conclusion.*** Smart technologies unclose significantly potential for improving quality of life. Today, the evolution of smart buildings continues with the development of new technologies such as edge computing, 5G networks, artificial intelligence (AI), machine learning, blockchain, and advanced sensors.

Smart homes represent a significant step towards a more intelligent, convenient, and sustainable future. With the rapid technological progress, it can be expected that smart homes will continue to evolve, offering increasingly innovative solutions to better meet the needs of users.

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