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INFORMATION SUPPORT OF AUTOMATED TECHNOLOGY OF COMPUTER-INTEGRATED CONTROL OF BUILDING HEATING

The development and implementation of automated technologies for controlling heat pump systems, including during the computer-integrated control of the building heating process, allows optimizing the use of energy and resources, as was proved in the second chapter of this dissertation. In turn, the information provision of such technologies allows for accurate zonal control and regulation of temperature in premises and buildings, which optimizes energy consumption and, accordingly, minimizes heating costs.

The basis of the developed information support technology for the automated control of building heating using the proposed computer-integrated method of increasing the energy efficiency of the heat pump heating system is based on a model that includes the following procedures and functions [1]:

- monitoring of ambient air temperature, soil temperature and operating modes of functional elements of the system (Fig. 1: heating system, heat pump, heat accumulator and solar collector), as well as zonal monitoring of air temperature in the building;
- computer-integrated processing of monitoring data;
- automated control of the heat pump and modes of zonal supply of heat carrier to the building;
- analysis of the energy efficiency of the implementation of the proposed computer-integrated method of controlling the heating system based on heat pumps.

So, a generalized graphical interpretation of the proposed information support of the automated technology of computer-integrated control of heating of buildings in the form of a functional diagram and a block diagram, taking into account the known research results [2-3] is shown in Figure 1.

The basis of the mathematical description of the researched technology is the heat balance equation of the house [1, 4-5]:

$$T_{in}(t+1) = T_{in}(t) + (P_{HP}(t) - Q_{SUM}(t)) \cdot \Delta t, \quad (1)$$

where T_{in} – air temperature in the building; P_{HP} – power of the heat pump; Q_{SUM} – total heat losses; t – current time; Δt – analyzed time interval.

The parameter of equation (1), which is responsible for total heat loss (Q_{SUM}), can be calculated on the basis of the equation [1, 4-5] taking into account the components of heat loss through the walls, roof, windows and floor of the building:

$$Q_{SUM}(t) = k_{AIR}(T_{in}(t) - T_{out\ air}(t)) + k_{GROUND}(T_{in}(t) - T_{out\ ground}(t)), \quad (2)$$

where Q_{SUM} – total heat losses; T_{in} – air temperature in the building; $T_{out\ air}$ – outside air temperature; $T_{out\ ground}$ – soil temperature; k_{AIR} – the total coefficient of heat loss of the house through the windows, roof and walls of the house; k_{GROUND} – coefficient of heat loss of the house through the floor; t – current time.

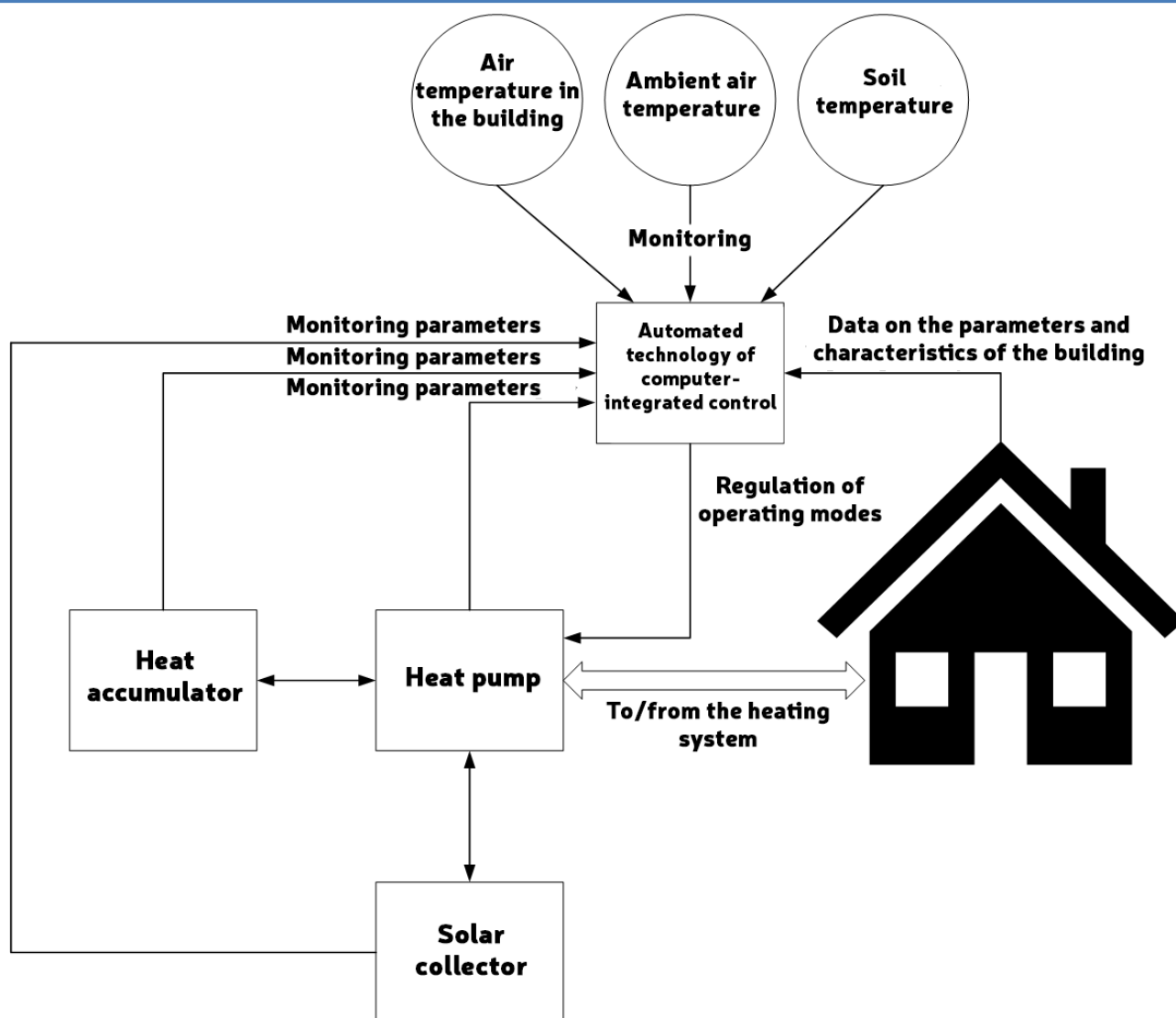


Figure 1 – Functional diagram of the implementation of the information model of the computer-integrated building heating control subsystem

Parameter of the thermal power of the heat pump (P_{HP}) in equation (3) is an adjustable parameter, and therefore requires the selection of an adjustment law. From the analysis of a priori information on the synthesis of temperature regulators of different classes of buildings [1], it was established that PI regulators are characterized by satisfactory properties. In turn, this type of regulator during building temperature control can be described by the equation:

$$P_{HP}(t) = K_p e(t) + K_I \int_0^T e(t) dt, \quad (3)$$

where P_{HP} – power of the heat pump; e – regulation error, which is calculated as the difference between the target and current air temperature in the building; K_p – proportional coefficient; K_I – integral coefficient; t – the current moment in time; T – analyzed time period.

CONCLUSION

Thus, research on the development of information support for the automated technology of computer-integrated control of heating of buildings, which was implemented in this subsection of the dissertation by synthesizing the functional and block diagram of the information model of the researched technology, as well as the mathematical description of the main stages of data collection and processing with the following generating heat pump

control signals in order to achieve and maintain the target air temperature inside the building, constitute the algorithmic basis of the software of the created automated technology of computer-integrated control of building heating.

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