POZNAN UNIVERSITY OF TECHNOLOGY ACADEMIC JOURNALS
No 81 Electrical Engineering 2015

Jan SZYMENDERSKI*
Dorota TYPAŃSKA*

MANAGEMENT OF HYBRID RENEWABLE ENERGY SOURCE IN SMART BUILDING

The paper presents how to manage renewable energy hybrid structure. The first section provides an example of a source hybrid PV/T panel and describes its construction and use. The next section shown the use of KNX installations for thermal management in rooms, presents examples of system configurations and work of the individual elements. The next part is devote to the presentation of the SCADA system and its use as a management software of hybrid sources. In the last part is present an example of model to simulate the operation of the entire system, its properties and describe their control structure.

KEYWORDS: Hybrid Renewable Energy Source, Smart Building, SCADA, KNX, PVT

1. INTRODUCTION

Renewable energy conversion systems are focused mainly on one type of energy processed, eg. heat or electricity. The main disadvantage of these sources is the strong dependence of the amount of energy produced by the current weather conditions and climate. From the perspective of the final user is quite troublesome. In this case, a good solution is to use a hybrid sources, for example PV/T (Photovoltaic Thermal Hybrid Solar Collectors), which shown in Fig. 1 [1].

Fig. 1. Cross-section of the PV/T module [1]

* Politechnika Poznańska.

The device combines the advantages of a photovoltaic cell with standard solar collector. Standard PV module efficiency decreases when the temperature is increasing. This phenomenon is unfavourable. PV/T modules limit decrease electrical efficiency because the heat is dissipated through the solar panel. This heat has a very good parameters and can therefore be used to keep temperature of eg. domestic hot water at the appropriate level. This solution significantly improves the economic balance of the entire investment [5].

Features of PVT panel [2]:

- integration of the two energy converters in one package,
- two types of energy (heat, electricity),
- better energy conversion efficiency,
- the ability to create cascading systems.

2. MANAGEMENT OF ENERGY RESOURCES

2.1. KNX intelligent building system

A necessary condition for the well-being of inhabitants of the building is to maintain adequate thermal comfort. Use in this area of modern building automation solutions and hybrid systems provide both greater comfort and optimal exploitation of the heating system of the object [7].

The most important element of the heating system is to control the temperature. In this chapter will be presented a heating control system " intelligent building KNX. Use of the KNX bus integrated control system allows the user to control the heating in all types of usable buildings. Initially, the intelligent temperature control had the highest use of residential buildings (detached houses, apartment buildings), but at the moment we see a trend, towards public facilities - especially hotels, and to a lesser extent office and schools [7].

KNX installation integrates all the functions of building management. It is used to turn on, control, signalling, regulation and supervision of electrical equipment installed in the building. It replaces the classical electrical installation. The plant automation system based on the power supply circuits are completely separated from control circuits.

The method of interaction of these circuits is determined by the user, what is important to easily allows modification of the scheme action [9]. On Figure 2 shows a schematic KNX intelligent building system.

KNX is a system containing devices performing the heating control. We divide them into two groups [8]:

- Control sensors
- Actuators called actors.

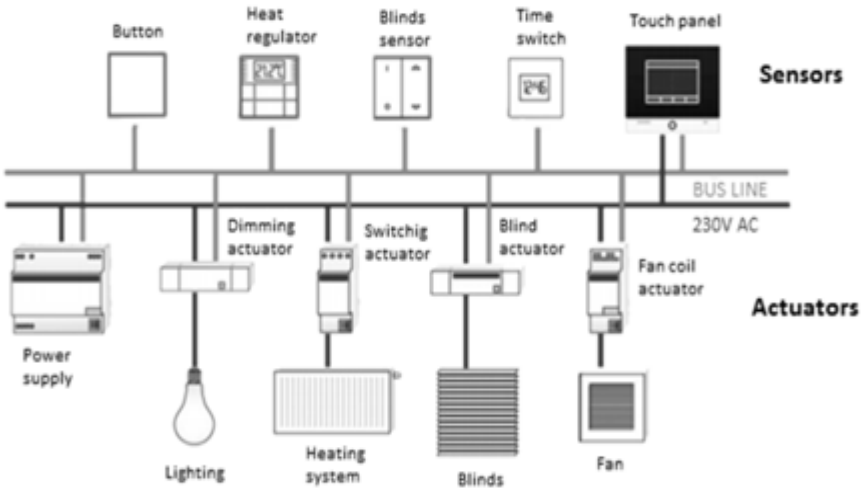

Fig. 2. Scheme of KNX system [10]

The task of the sensors is to send commands, which are then executed by the actuators, in the form of switch (on / off) valve for full temperature control. In a system is also possible programming the temperature depending on the time of day as well as the presence of members of the room. On Figure 3 shows an example of the sensor and actor manufactured by Hager, which controls the heating system of the building.

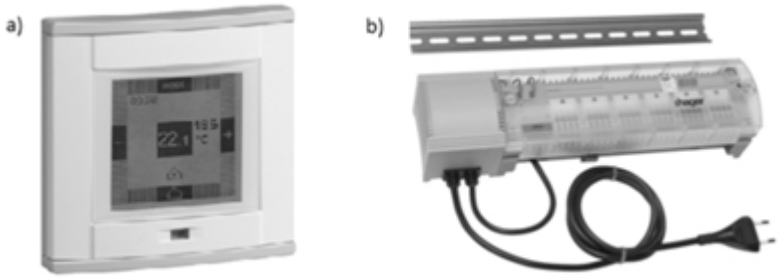

Fig. 3. Control elements the heating system of the building: a) sensor - temperature controller, b) actor - heating controller [3]

An essential element of the heating control system, is regulator. On the basis of the information received from the room placed sensor (measured temperature and the set task) developed a control method radiator valve [7]. On Figure 4 shows a block diagram of the temperature regulation.

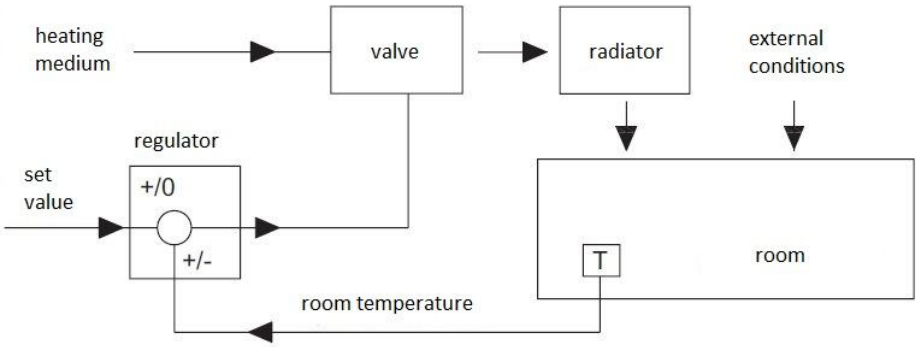

Fig. 4. A block diagram of room temperature control by sensor [4]

2.3. SCADA systems

SCADA (Supervisory Control And Data Acquisition) systems have been widely used in the surveillance of production processes. Its main functions include the collection of current data (measurements), their visualization, process control, alarming, and data archiving. In the case of used locally renewable energy sources is very important, because it is necessary to appropriate energy management and usually that is not available on a standard smart building [6].

In this paper, Citect SCADA software was used. With this software, the installation hybrid model was created consisting of the following elements:

- PV/T solar panel (electrical and thermal energy source),
- hot water tank,
- receiver of heat (heating, domestic hot water),
- circulation pumps,
- electricity storage (battery),
- receiver of electricity (lighting, heating and other electrical).

Figure 5 shows a model of a managed installation of SCADA level

This type of installation is most common used in residential buildings. In this case, it is important that parameters of supplied energy and the quantity it are consistent with the requirements of users. Solar energy sources are assumed to be able to work only during the day, while good sun exposure. Users may need power at any given time the day, when you cannot obtain it directly, so the model used energy storages. During the day when solar energy is available PV/T panel allows the capturing and storing in the appropriate reservoir. The temperature of hot water and air in rooms is constantly maintained at the level set by the user. Also, electricity can be used on a regular basis. The purpose of

the software is to maintain the preset by the user parameters and optimum use of available energy.

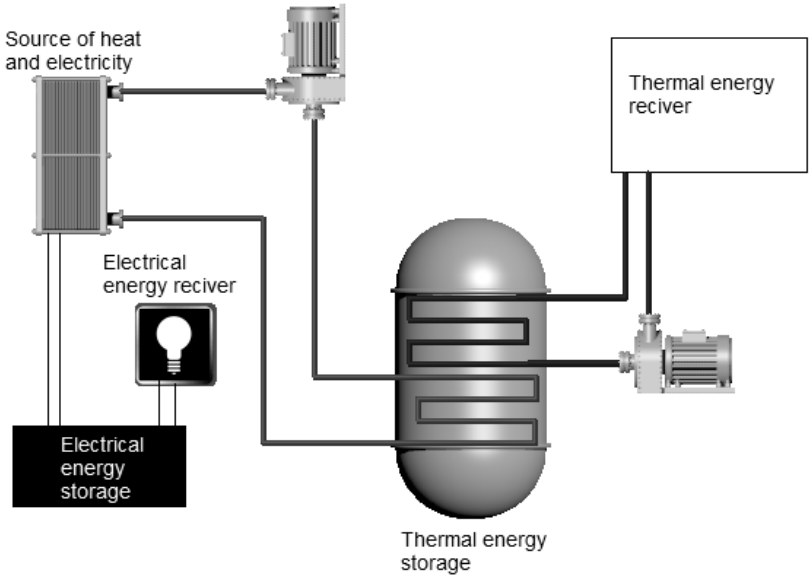

Fig. 5. A simple energy conversion system with a heat buffer visible from the SCADA

SCADA software also allows communication with external actuators. In professional versions of the software, there are several libraries allow transmissions from different types of protocols. This makes it possible to combine different types of installation management, for example, adding to the KNX [6].

An important feature of the program are also alarms and reports. They allow to create usage statistics, determine the current and projected energy consumption. Suitable alarm setting improves the safety of the installation. They inform the user about the risks or problems that interferes with the regular operation of the system [6].

3. CONCLUSIONS

Development of renewable energy systems and the desire to protect the environment require to use of increasingly complex management systems. Due to the capricious nature of these sources are not sufficient standard systems based on the principle switch (on/off). An example of such a source is discussed PV/T panel. Currently used installations cascading from its use as a substitute for a standard building facades.

Features of the proposed control system
- heat control in the building by KNX,
- energy management achieved by PV/T panel by SCADA,
- energy storage and use it later,
- able to join the next sources of energy.

In modern control systems should be aware of the flexibility of such a system. This will help in the future to better fit control systems to the current demand for energy. The presented model can be used to manage more hybrid sources, capable of processing different types of energy.

REFERENCES

[1] Alzaabia A. A., Badawiyeha N. K., Hantousha H. O, Hamid A. K.: Electrical/thermal performance of hybrid PV/T system in Sharjah, UAE, International Journal of Smart Grid and Clean Energy, vol. 3, no. 4, October 2014.
[2] Głuchy D., Kurz D., Trzmiel G.: Photovoltaic thermal as a hybrid form of obtaining energy from solar radiation,Poznan University of Technology Academic Journals, Electrical Engineering Issue 79, Poznań 2014, pp 175-180.
[3] Product catalog of Hager
[4] Radajewski R., Kamińska A.: The influence of heating control in the KNX installation on building energy efficiency"(in Polish), Elektro- info, no 11/2008.
[5] Rekha L., Vijayalakshmi M. M., Natarajan E.: Photovoltaic thermal hybrid solar system for residential applications, International Journal of Research in Engineering and Technology, Volume: 02 Issue: 10 | Oct-2013.
[6] Schneider Electric: CitectSCADA user guide, October 2010.
[7] Sowiński K.: Use of the KNX system to control the heating in the building (in Polish), Elektroinstalator no 9/2003.
[8] Typańska D., Jarmuda T.: Improving the energy efficiency of lighting through the use of KNX system, Przegląd Elektrotechniczny, No 7/2014.
[9] http://www.knxpolska.org/info_o_systemie_knx.html
[10] http://www.light-and-magic.com/knx.html