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HOW CAN A BUILDING GET INTELLIGENT?

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Abstract: Due to the cooperation of the University of Debrecen, Faculty of Engineering and University of Oradea, Technology and Engineering Faculty a Hungarian-Romanian Research-Development Platform for constructing intelligent buildings overlapping borders (abbreviated name HURO) has been founded in the framework of the project. The main research filed of the University of Debrecen, Engineering Faculty is facility energetics. The already existing research capacity is suitable for starting researches in the field of building mechatronic. This research field is quite new in Romania, because there is still no expert researchers and experts in this field. Therefore the University of Debrecen, Engineering Faculty completes in all possible aspects the researches conducted by the University of Oradea, Engineering and Engineering Management Faculty related to intelligent decision-making and controlling algorithms as well as innovative human-machine interfaces.
In the framework of this project a common research centre of building mechatronic is going to be realized that can be regarded unique both in Hungarian and Romanian relation and so the Mechatronic Engineering Master Building planned also commonly takes place and is strengthened in this centre. By developing laboratories both of parties can use the common research infrastructure without duplication. In this article we would like to explain the funds of the project at the level of terms and so reply to questions put so often: How can a building get intelligent?

Introduction

The European Union set up its document named Strategy of Lisbon having the objective to realize the society and economy based on dynamics, competition and knowledge, which composes guidelines and schedules concerning the future of the European Union with respect to the processes of globalization. In this connection the European Parliament and Council approved on the 16th of December, 2000 the directive „Energy Performance of Buildings". The directive was published on 4th of January 2003 in Official Journal and this day also came into effect. The main objective of the constitution of the European Union is the maintainable development — i.e. meeting the needs of the present generation without depriving the future generations from the possibility of meeting their needs. This is a principle influencing all policies, strategies and measures and requiring the formation and realization of the economical, social and environmental protection policy by strengthening each other. The main task to ensure the maintainable development is to force back, resp. invert the non-maintainable tendencies (climate change, energy utilization and energy import, (see Fig.1) danger sources of poverty, social discrimination, management of the use of natural sources, use of soil) confirmed also by the Contract of Lisbon[1].

[1] The Contract of Lisbon was elaborated by the intergovernmental conference with the participation of the representative of member states' govermnets. Both The European Committee and the European Parliament have taken place in the work of the conference The contrract was ratified by all 27 member

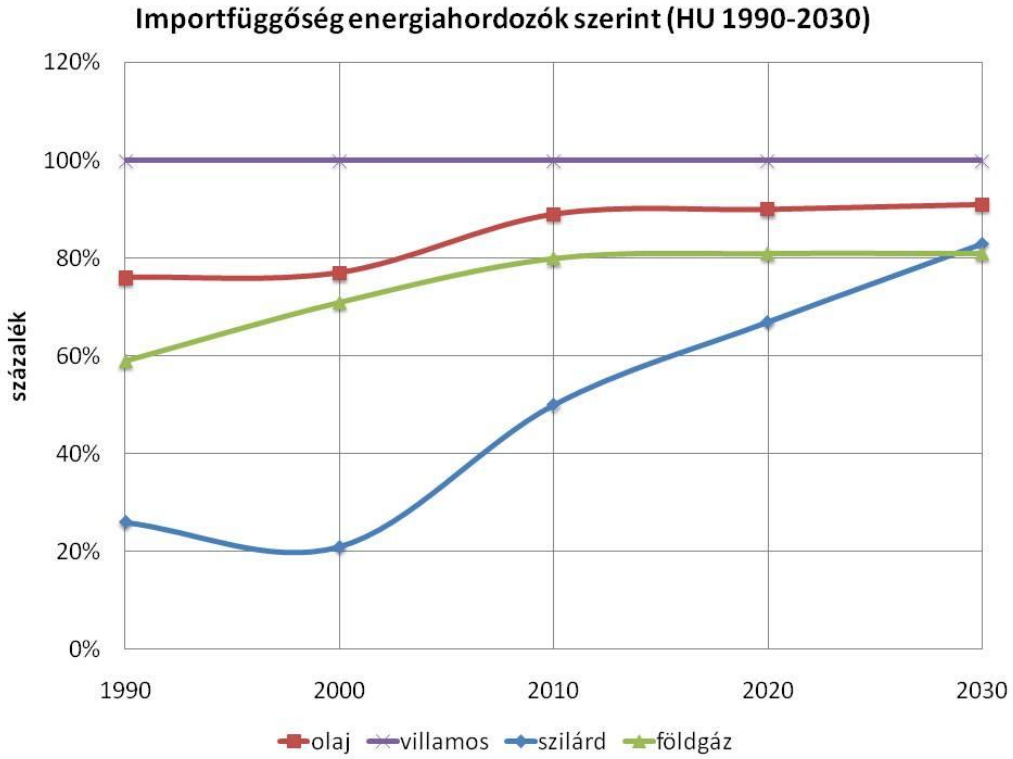

Fig.1 Import dependency according to fuels (EU 1990-2030) (source: [1])

Energy use of building in Hungary and Romania

Nowadays the finiteness of fossil fuels' stores and effect thereof can be perceived in all energy using branches as far as energy prices are concerned. The European Union has hardly conventional fuels and so imports natural gas and crude oil for the most part. According to the essay concerning energy needs , resp. different kinds of fuel the energy import dependency is presumably increasing until 2030. Since the countries having relatively big crude oil and natural gas stores are in another political palette than the EU member states (Russia, Turkmenistan, Azerbaijan, Georgia, Iran, Venezuela, etc.) and so the energy supply from these countries can not be regarded stable. Anyway, EU member countries shall make efforts to decrease their energy needs, but the maintainable development shall also be maintained, which also needs a lot of energy. The goal is o one hand to use the energy in the sectors using the highest quantity of energy with the highest efficiency and without any loss and waste. On the other hand the quality of the fuel and the goal of use shall be analyzed and where it is possible to use a fuel of lower quality, an alternative fuel shall be used. Since the operation of buildings is 40 % of the total energy use of the European Union, the efficiency of energy consumption shall in any case be increased in this sector as well [8].

The operation of buildings used to be between 1990 and 2008 and is presumably going to remain the main energy using sector in Hungary and Romania until 2030 with the 33 % share of the total energy consumption [5]. There are approximately 10 million flats in these two countries being in buildings built in different periods. The construction of these

states. All member states were entitled to chhose the way of ratification in accordance with their consitutional rules. Under Article 6 of the Contract of Lisbon the contract came into effect on 1st of December 2009.

buildings has been realized with different technologies, e.g. building materials of different qualities in heat technical aspect have been used. In accordance with this the energy consumption per square meter is quite different in residential building, but it is sure that these values significantly exceed the required ones [5,9]. Meanwhile under the EU 2002 Directive these requirements shall be rendered more severe in all five years. Only few buildings meet the requirements concerning the passive building in these two countries. The same rate can be perceived in public buildings, too. In the caser of planning and building of a building having a basic area of more thousand square meters is often left out of consideration that this building shall also be operated and will have an enormous energy need (in energetic aspect) which users can not pay. However, heat insulation techniques used in building renewals have already been completely elaborated. It is obvious that the energy consumption can only be reduced until a certain limit and the building can not be provided with heat insulation layer of any thickness, which it is not worth doing either.

Therefore, researchers carry out analyzes in other directions and the most important fields are intelligent buildings, building automation and building mechatronic. The new branch of mechatronic concentrates to mechatronic solution and possibilities of energy use of buildings. For conduction such researches building mechatronic research centers are established to which two laboratories belong. One laboratory is in Debrecen and the other one is in Nagyvárad. The activities of these two laboratories complement each other .and they are in permanent contact with each other

Fundamental terms of intelligent buildings

From primary School studies the term comes into the mind of anyone: “The building is an architectural work made by human hands. It includes one or more rooms closed round and so forms a closed complexity. Only constructions made of solid building materials are called buildings.”. If the building can fulfill its function automatically, i.e. without human intervention, resp,, with the minimum necessary human intervention, is called intelligent building. The different building mechatronic solutions are as follows

- central intelligence;
- divided intelligence or
- complex intelligence

By using of these kinds of intelligence devices of buildings are operated or their signals are received.

Buildings can operate with permanent human influence, on the basis of sensors’ parameters or by means of softwares loaded to controllers carrying the intelligence, from remote control separately or at the same time. The remote control can be realized by means of a press-button, control light, touch screen, one or more remote host, laptop.
The intelligence of buildings includes the following

- applied technology;
- user’s requirements;
- developer’s and applier’s software environment;
- exterior and interior sensors, as well as their parameters;
- climate control,
- illuminating engineering control;
- energy supply control,
- use of alternative energy sources;
- control of security technical systems, i.e. penetration signal and defense;

- handling of stay inside the building and other rights;
- fire alarm and extinguishing;
- control of the movement of windows and doors;
- control of consument electronic devices;
- automatic or manual control of household devices;
- computer network
- acquisition and evaluation of data relating to past and the accidental modification of processes o the basis of this;
- high flexibility;
- complete visualization;
- complete control and remote controllability

anyway all tasks arising during the operation of a building

For many people the term of intelligent building often exclusively means buildings constructed with Instabus (EIB, Connex or KNX) systems, although this term has already got more shaded. These are one of more of thousands of kinds of control system, by means of which the control and use of an intelligent building can be realized. Th following system elements can be incorporated into an intelligent building.

More known realizations of data communication:

- Inter-IC (I2C or IIC) data bus. I2C two-line synchronous data transmission system for connecting integrated circuits to each other.
- 2 or 4 lined bus systems with central or divided intelligence.
- Directly addressed bus systems.
- Serial communication(RS232)
- TCP/IP protocol
- RF, IR, Bluetooth or WiFi

Control solutions:

- microcontrollers which are computers integrated into one blank and optimized mainly for control function incorporated into individual devices, line air conditionals, boilers or consument electronics devices.
- Conventional automatisms (timers, light and heat sensors, movement and presence sensors).
- PCs using TCP/IP protocol .
- Control systems developed by means of micro-computers embedded operation systems.
- Industrial building control systems realized with PLC control.
- In industrial measuring techniques the use of Labview (National Instruments) platform. By means of this platform a PDA, incorporated PC system or a SCDA surface can be operated.

The complexity of systems does not facilitate the representation of more thousand data point on tableau or control panel at the same time. It is not necessary either, because the too many control lights and feed backs could get incomprehensive. Due to the decrease of prices of sensors and touch surfaces so-called SCADA systems are used more and more frequently. The base of SCADA is a PC display, touch screen or a unit consisting of these [4]. On the display more interactive displays helps us to find the way in the high quantity of data points. In all cases it confines only data being actually more valuable for users [6,7].

How can a building get intelligent?

If the building can fulfill its function automatically, i.e. without human intervention, resp,, with the minimum necessary human intervention, is called intelligent building.. For this the variants of classic mechatronic elements (sensors, evaluators-processors, intervenient) specialized for buildings are necessary [3.]. In many cases a disposable heat sensor can also alone fulfill its task without having been designed for a special building complex. Meanwhile mainly visible elements shall meet different aesthetic requirements in the case of use in an industrial establishment or building. Not only the measured parameters and the number of analyzed data points are important, but more the use of results of measurements. In the buildings a so-called brain or centre shall be established for controlling a number of systems and thousands of data points, which these systems can establish. The integrated approach requires the possibility to unify more available systems within one network by means of one software. The acquisition of data made by systems and their transformation into information facilitates the decision-making supported accidentally by an artificial intelligence and interventions ensuring the common state and comfort of persons staying in the building, which also leads to energy saving.

Nowadays an intelligent building shall have at least an integrated HVAC (Heating, Ventilation, Air Conditioning) system, entrance controlling system, observing system with camera and illumination regulating system. These systems shall be operated by taking the principle of energy saving into account (Fig.2)

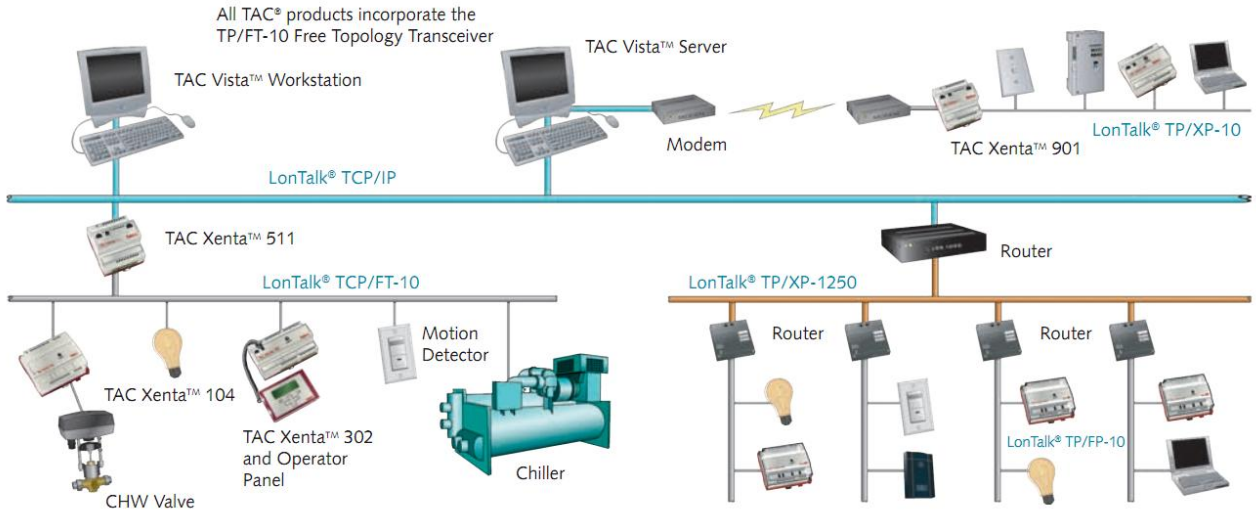

Fig. 1. The Schneider Electric TAC Vista system (source: [2])

Summary

According today's requirements the simultaneous control of the integrated HVAC (Heating, Ventilation, Air Conditioning) system, entrance controlling system, observing system with camera, illumination regulating system and energy efficiency are also indispensable in more simple solutions. In the realization of building mechatronic systems and formation of their mechanism attention shall be paid to the integration of different kinds of such systems besides avoiding complication and so a complete building or establishment economy can be formed. As a result of this the energy consumption decreases, the security increases, the reaction time is shortened and so an optimum environment can be assured for persons staying in the building and operation costs also decrease by 36 %. In the framework of our present project we would like to carry out developments assuring a comfortable, economic and safe environment in schools,

universities, hospitals, hotels, airports, shopping centers, factories, governmental buildings and all existing industrial branches by applying building mechatronic systems.

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