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DISTRIBUTED MEASUREMENTS SYSTEM FOR ACTIVE ENERGY SAVING

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Abstract: *the international context of saving natural and energetic resources, supported by national laws such as law 199/2000 regarding the efficient use of energy, we proposes to develop a new intelligent system, based on distributed measurement systems, intended at saving the resources consumed in buildings, considering each buildings usage specificity. The concept is based on new trends in environmental design, namely the concepts of e-building and environmental intelligence. As a technical achievement, the system have three main components: a data acquisition component, a storage, processing and presentation component and a command and control component and it is able to control the main energy consumption devices from an building: climate control system, illumination and water distribution system.*
Key words: *distributed measurements system, e-buildings, active energy management*

1. INTRODUCTION

In the global context of saving energy and natural resources, we have noticed an uncovered area related to the energy rehabilitation or the design of new buildings, consisting in actively saving energy and resources inside the buildings, by reducing consumption through monitoring and adapting lights, acclimatization systems' functions or sanitary spaces to users' habits, considering a number of factors. Therefore, using the concept of environmental intelligence, we tried to develop a distributed measurement and control system for efficient consumption of energy and natural resources within interior spaces, maintaining however the comfort level

2. CONTEXT

2.1 International context

In addition to research activities, the Commission has recognized that ICTs and ICT-based innovations may provide one of the potentially most cost-effective means for Member States to achieve the 2020 target. The two Communications adopted in May 2008 [COM(2008) 241] and in March 2009 [COM(2009) 111] are a first step towards creating a policy framework that will allow the energy-saving potential of ICTs to be widely recognized and exploited. With the right policy, ICTs can enable a new revolution in energy efficiency.

2.2 National context

The specific consumption for building heating and hot water in Romania have values about double to those from EU countries; as a direct consequence also pollutant emissions are higher. Acording to *Mladin E.C et al. 2005* research study the structure of energy consumption in annual energy balance of an average apartment built in the period of 1970-1985 is 21% for air conditioning, 55% for heating, 10% gas consumption and 14% for lighting.

It is noted that of the annual energy consumption of a building irrespective of its use, the thermal energy for heating and domestic hot water is the main annual energy consumption by about 75%. In all residential buildings, in Romania, efficiency of heat used for heating, hot water and food preparation is only 43% of the amount of the provided heat by sources which is unacceptably low. Unlike Romania, of the total final energy consumption in the EU, buildings in residential and tertiary sectors of the member countries consume 40.7%, being first, before transport and industry

3. MAIN MOTIVATION

To achieve a system able to reduce consumption of energy and natural resources, in terms of maintaining the comfort level of buildings with various purposes rises from both economic and social situation existing at national and international previously said.

In many buildings which have been implemented with projects to reduce energy consumption was found that the difference between measured consumption and the one projected to be achieved is disappointingly high, in some cases probably due to the use in the forecasting and planning of the systems, only of factors which did not take into account issues concerning the destination of these spaces, their mode of use and maintenance process of facilities**.**

In some projects to rehabilitate buildings in terms of energy efficiency were considered only the passive elements to conserve heat, namely were performed insulation work, including facilities changing by replacing old heating and individual air conditioning systems with general air-conditioning systems. In these cases, were found decreases in operating costs and thus consumption by up to 20%.

For both new buildings and rehabilitation projects of old buildings, have began to be used more solutions to conserve or reduce energy use in air conditioning (Rousseau et all 1994) or in the process of water heating or by using of solutions that transform the solar energy into electricity or heat or solutions that use wind power to provide natural ventilation in buildings or to be converted into electricity. Also it is noted that the interest of housing developers is granted for the use of an increasing percentage of resources which are referred above.

The main goal from the moment of control classic systems development for the things that are related with the comfort was the minimize of the energy consumption.

4. THE SYSTEM AND THE CHALLENGES

Applications of the intelligent methods in the buildings control systems appeared in a larger scale in the second half of the 90's. The artificial intelligence techniques are used both in conventional buildings control systems and also in bioclimatic buildings. For the subsystems control in intelligent buildings (Lopez L et al 2004) has been developed optimized intelligent control systems by including a series of evolutional algorithms.

The synergy between neural networks techniques, fuzzy logic and evolutional algorithms underlying Computational Intelligence is more used in the buildings control systems.

To solve the problem caused by non-linear characteristics of thermal comfort and physiological indices, of the times of delay and uncertainty of system algorithms include some adaptive fuzzy control techniques (Dounis AI, Manolakis DE 2001) for optimal comfort control and of economic comfort (Federspiel CC, Asada H, 1994). For water heating systems have been developed and successfully implemented a series of controller which use Neural algorithm -Back Propagation (Levermore GJ, 1992). Neural networks have been widely used in applications for energy saving in buildings in condition of maintaining or increasing comfort in Japan (Asakawa K, Takagi H,1994) where they were embedded in commercial products such as air conditioning, heating plants, washing machines, etc..

To receive benefit of the advantages offered by the control systems mentioned above in a way related to the level of a building is necessary to use a distributed monitoring and control system, able to take data and execute commands in some components of control energy systems building.

One of the issues outstanding in this area is represented by the fact that there are currently few solutions available on the market able to do one internal environmental control parameters taking into account all the above elements (Trandabat A et all 2009). More specifically, most of the existing controllers are focused either on the analysis of the particularities of the building, either on the primary analysis of human behavior but only in terms of a single controlled element: either heating appliances or air conditioning or lighting installation without link these controllers so as to obtain an increased effect of global energy saving, referring to all parts of the building systems.

To have such an approach we need an information network capable to take data and send commands linked to the entire arsenal of consuming energy systems or natural resources in the building. **A solution** that we will use to solve this problem is offered by wireless sensory networks (Pislaru M. et al 2009).

Development of microelectronics and miniaturization of mechanical structures led to the development of autonomous sensory nodes in terms of power, size increasingly smaller as the full registration process and communication functions these sensor nodes can form ad hoc network which in turn form the distributed sensor systems that are able to acquire data and process information from different situations. Such wireless sensor network has a tolerance to failure and a higher measurement accuracy than conventional monitoring systems, and normally these types of networks are less expensive both in the acquisition and implementation and in operation compared with alternatives solutions available that use only a few isolated sensors coupled to data transmission systems. An advantage of using these distributed networks of wireless sensors is that it can be located in difficult areas to continuously monitor the parameters of that area, and to process and transmit the data acquired a wide variety of applications.

Wireless sensory networks being able to monitor the environment where they are located, to process information and make decisions based on previous comments have pointed out especially the last time, being a viable alternative for the developed applications in various fields based on classical networks.

To identify the elements and challenges of the project I will enumerate them separately on each component module of the system in part.

The main challenges in implementing module of data acquisition, are that will be studied and performed communication protocols, between network nodes sensory of the building, who allowing data communication between network nodes, so that in case if a nod failure, it can be reported and nodes use like a routing point aren't scrapped, but can continue the bidirectional transfer of dates from other adjacent nodes. Another element to be considered is the transmit power and data transfer protocol that, depending on the type of building, construction materials and the distance between nodes, to ensure the transfer of data between network nodes with high confidence and also to increase life of a node.

For component storage, processing and presentation of information, the main elements to be studied and solved are related on implementation of database, the configuration it, the query mode and not at least by securing and controlling access to these data. We have studied the structure of databases in terms of number, type, conditions and resources monitored so that data supplied to logic controllers lead to their behavior as appropriate to the intended purpose: energy efficiency, increased comfort.

The questions that we have to respond in achieving a more effective implementation of ***intelligent module for command and control*** are related to parameters monitored, the conditions that can be transmitted in order to reduce consumption system, which are normal values, which are the limits the system should be within, what represent the optimal thermal comfort and visual limits. Eventually, by implementing an intelligent system that uses as data drive, data storage component, the system can identify the user's preferences, based on history and using these constraints to be able to redefine for user, the comfort parameters and the solution for minimum consumption of resources.

5. CONCLUSION

In the global context of saving energy and natural resources, we have noticed an uncovered area related to the energy rehabilitation or the design of new buildings, consisting in actively saving energy and resources inside the buildings, by reducing consumption through monitoring and adapting lights, acclimatization systems' functions or sanitary spaces to users' habits, considering a number of factors. Therefore, using the concept of environmental intelligence, we developed a distributed measurement and control system for efficient consumption of energy and natural resources within interior buildings spaces, maintaining however the comfort level.

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