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Using intelligent Building Energy Management System for the integration of several systems to one overall monitoring and management system

"Sotiris Papantoniou, Stefano Mangili, Ivan Mangialenti" *

"Schneider Electric Italy, EcoBuidling"

Abstract

In the CommONEnergy project the interoperation and optimization of active systems in shopping malls is performed by using an intelligent Building Energy Management System (iBEMS) which integrates open communication protocols for speaking with several industrial systems. The iBEMS assures the communication of several systems using open communication protocols in order to transfer the required information while on the same time provides a Human to Machine Interface (HMI) for the control and monitoring of the connected systems. In parallel the iBEMS stores historical values for future comparison of the performance. With the operation of the iBEMS the energy manager of a building can overview in real time the operation of all the systems' components and take decisions which can assist with the proper operation. In parallel the programming routines of the iBEMS adjust automatically the operation of the systems using inputs from the installed sensors and from external data (e.g. weather forecast).

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1. Introduction

Environmental, economic and policy reasons mandate the reduction of the energy consumption in buildings. The increase of CO2 level in the atmosphere, the elimination of fossil fuels and the stability of the energy grids are among the causes which imply the reduction of energy consumption in the building's sector. Energy consumption in buildings measures at 40% of the worldwide energy consumption [1].

* Corresponding author. Tel.: +393298803005
E-mail address: sotirios.papantoniou@non.schneider-electric.com

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The European Directive for n-ZEB (nearly – Zero Energy buildings) requires the minimization of operation cost for heating, cooling and lighting systems. However, the proper operation of the systems and the required comfort level should be continuously monitored and adjusted to verify the proper operation. In large buildings, like shopping malls, several systems from different supplier are installed. The proper communication of a central management system with the several installed systems for information exchange and higher control commands leads to the required energy saving through their whole operation period.

Energy efficiency in buildings can be achieved using either passive or active energy efficiency techniques. Passive energy efficiency techniques, such as wall/ roof insulation or fenestrations with low-e glass and window frames with low U-value contribute significantly in the reduction of energy consumption for heating and cooling. Although passive energy efficiency techniques reduce energy losses from the fabric of the buildings, energy consumption can also be reduced by adjusting the internal gains, which directly affect energy consumption. Moreover, during the summer period, when cooling is mostly required, the surplus internal gains increase indoor temperature, which is directly related to the cooling loads.

In a shopping mall, the refrigeration, HVAC, lighting and energy storage (thermal/ electricity) systems are installed are communicating with the iBEMS. In parallel the iBEMS working as a high level controller allows for example the energy exchange between systems and using the energy losses of one system (refrigeration) as energy source of another system (HVAC). In long term operation the iBEMS creates report for demonstrating the proper operation of the systems or for identifying systems malfunctions of possible optimizations. By continuous monitoring the operation of all systems the required energy performance is achieved and thus allows to achieve and maintain a n-ZEB.

The requirement for automation in buildings sub-systems is proposed also by the European Standard EN 15232 [2]. The European commission through this standard stresses the shopping mall owners to install Building automation systems for energy saving. The standard has 4 symbols from D to A representing from the non energy efficient system to the higher energy performance building respectively. The European Standard EN 15232 estimates the energy savings up to 30 % by applying building automation control systems.

The paper consists of 2 more chapters. In chapter 2, the state of the art of control systems for several sub-systems is presented while in chapter 3, the architecture of the proposed iBEMS is presented. In chapter 4, the developed iBEMS is presented including the graphics of interconnected systems and the control rules that define their operation.

Nomenclature

iBEMS	intelligent Building Energy Management System
HVAC	Heating Ventilation and Cooling
n-ZEB	Nearly Zero Energy Buildings

2. The importance of BMS for combined sub-systems

The existing BMS provided by the suppliers of active systems usually monitor and control their own system individual from the others. For example, a security system using PIR sensors for presence detection uses the sensors only for it. In parallel, a system for the operation of the artificial lights uses extra PIR sensors for activating the lights when someone enters an area. The 2 different sensors send the information to the individual monitoring and control systems. Increasing the capital cost for the sensors and the cabling. In parallel, information from one sensor located in an area (ex. Indoor air temperature) cannot be used by another system (ex. Venetian blinds) if the sensor value does not arrive in the venetian blinds control system and is used in the control algorithm. Nikol Papadaki [3] has shown the requirement of using indoor air temperature values.