ECOLOGICAL INTELLIGENT HOUSE BETWEEN MIT AND REALITY. AUTOMATIC VS. DOMOTIC HOUSES

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Abstract: Lately, even in Romania, the interest in intelligent (ecological) houses has begun to take on proportions. Gifted with curiosity, but above all by reorienting to a new lifestyle, people are looking to find out more about them. Although the construction of intelligent houses is not simple, but eliminates many of the harder stages of a classical construction, the future homeowners omit, due to lack of information, this variant, especially in the context in which we do not yet have a good information filter on this subject, which will concretely give us the benefits we can provide, especially if we refer to domotic systems. Through this paper I would like to emphasize a number of elements to be considered in the context of moving from the current ecological house to the intelligent house, elements that are mainly related to the correct understanding of the intelligent house concept - risks and flexibility, advantages and disadvantages, estimates of funding and so on.

Keywords: intelligent houses, upgrading trends, home automation systems, automated houses

1. INTRODUCTION

About *intelligent houses*, it's been discussed for a long time. Lately, even in Romania, the interest in intelligent (ecological) houses has begun to take on proportions. Gifted with curiosity, but especially by reorienting to a new lifestyle, perhaps more comfortable, people are looking to find out more about them [1]. Although the construction of intelligent houses is not simple, it eliminates many of the harder stages of a classic building, the future homeowners omit, due to lack of information, this variant, in the context where we do not have a relevant information filter on this subject, to give us concrete benefits, especially referencing domotic systems [2].

Some authors speak enthusiastically about the *house of the future* as an excellent but distant idea (Fig. 1). Others say that the notion has already lost its credibility due to the great promises but not respected. Others consider *modern homes equipped with digital technologies* to be a contemporary embodiment of *smart homes* [3]. Finally, others believe in the reality and contemporaneity of intelligent houses, but deny the contribution of multimedia equipment to increasing the house intelligence [8]. Everyone is right in their own way, because nobody has yet defined human intelligence. Why would it be different for houses?!

However, we can discuss some elements whose presence is obligatory in a smart home: *sensors* that collect different information, *control elements* that allow control of home-based systems, a *communications network*, and a *central unit* running programs that record and monitor information, makes decisions and orders according to these decisions.

In addition, with the help of some *software interfaces*, the owner of the house can access all the information collected by the central unit, can call all the house orders individually or grouped in scenarios and configure how the house makes decisions [1-3].

FIG. 1. Overview of the Smart Ecological House concept (source: www.shaspa.com)

Through this paper, we want to highlight a number of elements to be considered in the context of moving from the current ecological house to the intelligent one and from house-to-home [4], elements that are mainly related to the correct understanding of the smart home - risks and flexibility, advantages and disadvantages, funding estimates etc.

2. SHORT HISTORY OF INTELLIGENT HOUSES EVOLUTION

Most of the achievements in the field of construction and home improvement have transformed the prehistoric cavern into the home that we have today. The next step towards completing this home is its automation - it transforms the usual *passivity of residence* into the *intelligent interaction of matter with human spirituality*. The home gets new valences, especially through the intelligence center (central unit) that controls most of its attributes [3]:

- *functionality* - controls lights, blinds, temperature, hi-fi systems, and any other electrical or electronic device, both inside and outside, either via the Internet or locally using remotes, laptop, touchscreen;
- *energy management* - reduces energy consumption by optimizing the operation of the electrical, electronic, sanitary and thermal components of the dwelling;
- *security systems* - allows the presence of tenants to be simulated during their absence, allows detecting and reporting burglary to neighbors, family, security firm, and triggering a predefined scenario for removal of intruders. Video surveillance also allows viewing the activity of children, bonuses and the entire residence at any time and at any distance, thereby increasing the effectiveness of the security system;
- *intelligence* - the smart touchscreen can serve as a control panel for home automation, also performing the intercom function, or allowing the Internet access, even outside the system;
- *comfort* - preset lighting scenarios for certain types of activities (party, dinner, film) requiring different levels of light intensity and multiroom audio-video - which allows via an audio-video server to listen to music or watch a show in each room of the house, according to individual preferences.

In recent years, the automation system for green houses has made tremendous advances in technology, applications and design. By enabling technology to enter the living space, people have improved comfort by making everything even more functional. The discovery of the advantages of home-made systems to a living space is possible thanks to the experience and technology, the specific know-how that has replaced the natural electronic systems with artificial intelligence systems (computational applications). The development of the idea of a smart ecological house in practice started from the "Smart House" comedy produced in 1999 as a film adaptation of Ray Bradbury's "The Veldt" - a series of smart gadgets (Fig. 2) transformed the lives of tenants house in a series of up-to-date SF scenarios that had a lot of publicity.
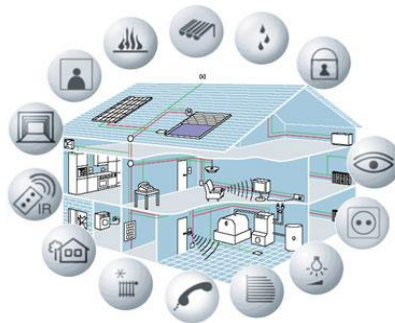

FIG. 2. The main attributes (domotic systems) of intelligent houses (source: /i45.servimg.com)

The success of the film gave thought to automation companies, and so the first elements of the intelligent house did not come to an end; although at first it was just about lighting, watering the garden, and video surveillance, the list of things that a smart home could make has grown considerably.

3. WHAT DOES THE INTELLIGENT HOUSE CONCEPT MEAN?

3.1 Principles of operation and behavior

The concept of "*smart house*", relatively new for Romania, appeared about 30 years ago and was implemented in most developed countries across Europe. The unprecedented expansion of the computer in all spheres could not affect the domestic domain. This is the reason for the emergence of *domotics* that deals with the applications of computers and robots in the household domain. The concept of "*intelligent house*" defines a modern living space that uses modern technologies for the automation of all life aspects (Figure 3), responding exactly to the basic human needs of *comfort*, *functionality* and *safety* [4,7].
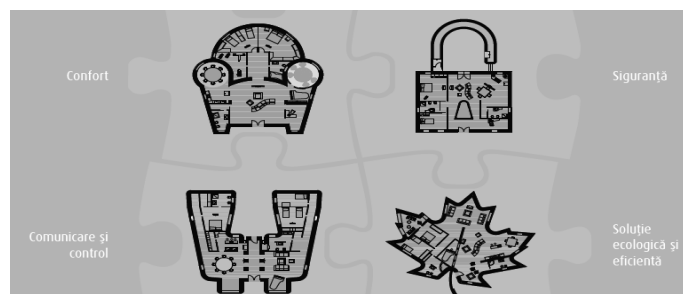

FIG. 3. Human fundamental needs of the smart home [1-3]

The role of an intelligent house is therefore to improve the comfort of tenants and to simplify their touch by *simply pressing a button* (the keys of a remote, telephone or other communication device) [6,7];

So many functions can be used to automate the house and its exterior, such as: controlling the lights in the yard, throughout the house or in certain rooms, and conditioning the rooms; family and property security; managing the multiroom audio system; manual or scheduled operation of blinds, curtains and blinds; operating the watering facility and controlling the water temperature in the pool; pet feeding, etc. In principle, all individual electrical and electronic systems in the house are combined into a single unit that makes centralized coordination of all functions possible, whether inside the home or remotely via the mobile phone or the Internet. Domotica also has an impact on protecting the environment by reducing energy consumption (eg when a window opens to interrupt the heating system) [5].

The general operating principle of an intelligent house consists in the networking of all household electrical appliances that are constantly controlled by a "centralized intelligence" (intelligent server) with an accessible interface. Orders can be made with a universal remote or via a portable phone, a touch screen, and more. All these elements make possible complex adjustments, adapted to the life of each tenant, by realizing and following "scenarios" that are activated (repeatable, in the form of a predefined circuit) depending on the situation (Fig. 4).

FIG. 4. Various reference scenarios for smart home [3]

For example, the "Going to work" scenario, with a simple click, would mean turning off the lights, opening the garage door, switching the heating system to a standstill and, of course, closing the shutters and the garage door within 15 minutes. Similarly, the "Return from Work" scenario determines actions in the opposite direction: the blinds rise, the boiler starts, the doors open, etc.

As far as security systems are concerned, they usually contain a video camera, audible and intrusion sound signals, while some more performing systems can automatically contact the owner's phone number or a security firm, whenever there may be a gas leak, a flood, smoke or "unwanted visits".

The realization of an intelligent (ecological) house implies, among others, a specific intelligence system (smart integrated kit) that makes everything functional, associated with a modern (ecological) nature inspired design while taking into account the elimination fire risks or other collateral damage, in compliance with established Building Management Systems (KNX) [8].

FIG. 5. Various benchmarks for intelligent house management (BMS, KNX)
(source: www.dmc-technology.com/knx-technology)

In the current market, KNX technology (those who have also produced the Internet, radio etc.) used by millions of customers in Europe, Asia and America (Figure 5) is the most appreciated. Also CEDIA, as an international professional association, produces furniture and electronically-integrated natural systems for smart homes, in collaboration with architects specializing in the design of ecological homes [8,9].

3.2 Technical and economic indicators

Nowadays a building no matter what its destination can not be without proper IT management to ensure its administration and maintenance under efficient conditions. Today's technology allows the development of computer-aided programs to set up a multitude of equipment and to execute, according to some scenarios, everything that is necessary and sufficient for the proper exploitation of the building and the habitat.

New technologies - Building Technologies - have been developed in the form of unitary systems integrating Building Management Systems (BMSs). Implementation of a BMS is aimed at: increasing the comfort of those living or operating in the building, building and people security, building safety, simplifying operation and maintenance operations, substantially reducing maintenance costs etc.

A home equipped with such a system offers more comfort, flexibility, elegance, ease, increased security, ambient, but the most important thing is to reduce maintenance costs by optimizing electricity and heat consumption. The systems are modular and extensible, which means they can be deployed partially and in stages, depending on the client's time requirements. In the world, there are many home automation manufacturers, some of whom are specially engaged in the development / implementation of various innovations or technologies, and others who are renowned manufacturers of classical electrical equipment and have approached this field of applications, aware of the impact which he will have on the real estate market in the future.

Sooner or later, all buildings will end up having such amenities. We are already talking about the BMS (Building Management System), without which no building is currently being designed, with a larger or smaller volume of work to be carried out.

One of the solutions on the US market and verified over time is the one proposed by the American company HAI (Home Automation, Inc.) founded in 1988.
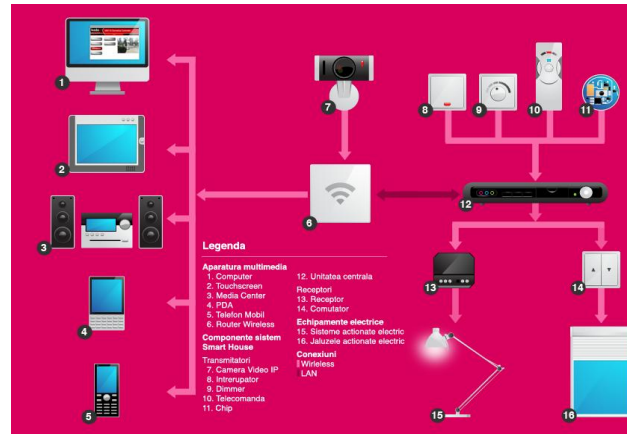
FIG. 6. The main components of the domotic system associated with the intelligent house
(source: www.dti.ro/assets/images/content/arhitectura-sistem.png)

The HAI solution is modular and includes several systems that embody, to a greater or lesser extent, the options expressed by the customer. Regardless of which of the variants available on the market are preferred by the client, the following components are found (partially or fully) within the domotic system associated with the intelligent house (Fig.6): *the central unit* - which makes possible the unitary functioning of the system, having the role of multiplexer for the rest of the components; *console* - which allows programming of system components and system functions desired by the client; *omnitouch screen* - with complementary functions to the console, which visualizes the state of the entire system; *HI-FI system* - stand alone system that can be connected to the centralized central control unit.

3.3 Risks and flexibility. Estimates of costs

The multiplication of stress factors in the environment in which we live determines us to seek more and more solutions in order to create a balance between the tension and mental and physical stress of each day and the moments of relaxation; thanks to this, the intelligent house has become an increasingly familiar space, providing added value to any construction. Additionally, the computational systems of the intelligent house have evolved to an extent that responds to higher aspirations in terms of comfort, safety and control of the house.

IT systems that make the move from the green house to the smart ecological house extend the traditional concept of "electrical systems" perceived as simple lighting systems and sockets. The new concept basically means equipping the home with advanced electronic systems that are designed to meet specific needs, perfectly capable of providing useful applications. Integration of all these features creates an advanced but easy-to-use, time-lasting and highly flexible system that can be modified and expanded at any time to meet new needs.

An intelligent house has the property to provide that unique feeling of "I feel good at home," every day, turning the house into "home" in the true sense of the word. The intelligent installation blends in perfect harmony, control of all lights, sockets, heating, air conditioning, motorized shading equipment, audio-video equipment, security features, irrigation system and much more. Child safety, family comfort, energy savings, exclusion of electric shock hazard, circuitry presence simulation etc., all these benefits are really important for intelligent homes. In addition, a truly intelligent installation will need to be intuitive and easy to use in the everyday life of all generations, the tenants of the building. It also needs to be *adaptable over time* to meet *the new requirements of changing rooms* - not a few times, at a certain age, the child's room becomes unruly and will receive a new destination, and a larger room will become the onomastic gift.

A smart home will be able to provide all the features needed for the new room. The intelligent house provides the command or visualization of the equipment from any area of the property, including remotely when we are away.

Smart home projects, as *flexible and discreet control systems*, are becoming more widespread on the Romanian construction market, as a building is truly considered to be complete only when it offers besides shelter, a multitude of advantages: *low energy consumption*, *increased safety*, *easy maintenance*, *low environmental impact* through *optimization of consumption* and *substantial utility bill depreciation*.

Another aspect that is worth mentioning about the intelligent house is that the central home system can easily integrate a variety of systems such as: *climate control and light control*, *local and remote audio and video surveillance systems*, *home-cinema and audio-multiroom, electrical socket system*, *fire detection system*, *burglary or other incidents*, *the automation system of the entrance and garage doors* etc. All of these systems can be controlled at any time, manually, or by setting predefined scenarios for different daily situations: when you leave or return from work or vacation, when you wake up or go to sleep, when the whole family lives in the house, and so on Also, the flexibility of home-based solutions derives from their ability to implement and adapt to various areas: apartments, houses, villas, holiday homes, hotels, office buildings, etc. An intelligent house is domotically designed modularly so that it can be completed in time and in need with other components, which of course have adequate prices. Taking into account each piece of equipment that is very personally substitutable to humans in the form of domotic systems integrated into packages of different needs (for residences, hospitals, office buildings, etc.) it is found that the great disadvantage of an intelligent house is the high price high compared to classic electronic systems.

In Western Europe, for example, a traditional interior fitting (just the electrical installation) for a medium house as surface and comfort can reach 12-13 thousand euros, while a domotic system would require an investment of over 25 thousand euros, which would, of course, dampen through the substantial savings caused by the intelligent system in about 7-10 years in the opinion of the specialists.

The vast majority of companies that make smart homes systems available to the public support a reference price of around 40-50 euros/m^2 compared to 20 euros/m^2 for an ordinary electrical installation. There is, however, the choice of the beneficiary only of integrated intelligent systems packages, such as lighting or sound control, in which case it can reach 800-1000 euros for a 70m^2 apartment. The price differs depending on the complexity of the chosen system, ie the customer's needs to be met. A basic system from AVITECH, for example, starts from 10,000 euros, and one complex is around 400,000 euros for a villa. The target audience for such equipment is the high-income, high-income, self-realizing, high-status, loving and willing to convert their home into a special place in a place of indulgence.

3.4 Advantages and disadvantages of a smart home

The most common question is probably "Why does a smart home benefits us?" So we will try to answer you in the next few lines. In addition to the cool factor, intelligent homes ease the lives of the tenants, provide increased energy security and energy efficiency, not to be neglected today. If we talk about security, then we need to take into account scenarios where we no longer need keys, can use fingerprint authentication, voice, retina to open the entrance door. For example, we could give a remote friend access for a limited time if we are not home.

We can also access the video cameras in the house in real time to check out the new baby that I left to take care of the children.

And if an intruder has been detected, we can be notified immediately on the mobile phone along with the authorities that will no longer have to be notified by phone, as is happening today. On the energy efficiency side, think that a radiator forgotten when we go to the office consumes energy until we return home, even if empty housing is not to be kept at the same temperature of 20-22°C as when we are home. We can also set household appliances to consume electricity only in times when the price per kW is lower.

In the future, other utilities such as water and heat may be priced differently depending on the period of the day, so any optimization of consumption in this sense will translate into low maintenance costs. On the entertainment side, wireless systems will allow virtual room partitioning and individual control from a central point. Possibilities are unlimited and will probably prove to be useful in the future.

Another important disadvantage is that anything connected to the Internet is vulnerable to cyber attacks. A good hacker is able to get into a secure environment, and smart homes will use the Internet connection to control access, so they're vulnerable. Changing stickers to security firms and antivirus manufacturers will not solve this problem. Informational attacks are a reality of today's day, unfortunately, so it is wrong to believe that we can not be affected by them. In addition, in a world of more and more intimacy, more data will be collected about us through Internet-based devices. And this must be considered and balanced before deciding to "wake up" our home.

4. CONCLUSIONS

The practical solution, leading to full and conscious control over the home, provided by the intelligent house, highlights the possibility of interacting with the artificial and natural environment. The natural-artificial symbiosis through the complexity of the functions behind a user-friendly interface, with customizable menus for easy accessibility, reveals that we need electronic systems and equipment to an acceptable level in everyday work that not to cause undesirable effects on the safety of the environment or society.

In recent years, the automation system has made huge advances in technology, applications and design. By enabling technology to enter the living space, people have improved the level of comfort by making everything more functional. The discovery of the advantages of home-made systems to a living space is possible thanks to the experience and technology, the specific know-how that has replaced the natural electronic systems with artificial intelligence systems (computational applications).

The coming years will be decisive in the maturing of smart home technology and the increased consumer interest will lead to the development of a diverse range of products more suited to meet the needs of automation of the space we live in. As I mentioned at the beginning of the article, the supply of intelligent home appliances is now quite limited, prices are high and standardization is lacking, but this will not disturb those who really want a smart home.

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