Saving Energy through Technological Development of Residential Buildings

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Abstract:

The technology has affected on residential buildings through the great progress made in the scientific and technological progress. which necessitated considering the reconsideration of architectural design using the energy of the guide whether smart systems or solar energy or both. These changes coincided with the increase in applications of technology in the field of architecture, and work on the provision of energy, which is considered as one of the most important issues affecting the consumer and the quality of the energy system and the global environment. knowing that residential buildings consume high energy with domestic appliances from air conditioning and lighting, making it one of the most vital areas for the impact of energy consumption.

Keywords: Recent technological developments, intelligent architecture,energy saving.

research importance:

To define and educate the society on the importance of technology, and to find solutions for consumption and waste of energy from the systems of air conditioning, lighting, and electrical appliances that are not needed at the time of non-occupancy in the dwelling and the consequent increase in costs.

research Objectives:

a. Highlight the importance of technology and developments in building systems because of its benefits and energy consumption.

B. Create an internal environment that works on the user's comfort and supports the energy consumption consumed by it.

C. Applying the concepts of smart systems and solar cells by increasing the desire of users to attract new technology, building new homes based on technology and the development of existing housing.

D. Acquiring energy and providing the consumer with housing.

Research Methodology:

In this paper, energy control depends on the first two ways of saving energy through using smart systems, and second acquisition of energy using solar cells. This will be clarified by the following points and as in Figure (1):

- Digital technology.
- Control energy through intelligent systems by saving energy.
- Environmental technology.
- Control energy through solar cell systems by acquiring energy.

- A study case in which the energy consumption and control solutions are calculated to reduce cost (electricity bill) .
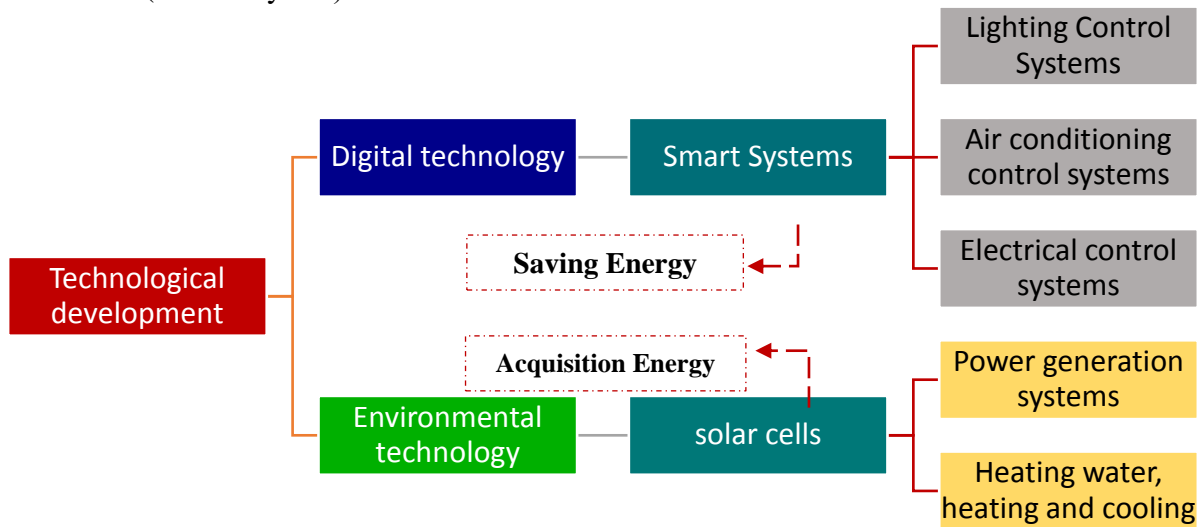

Figure (1) Research Methodology

Introduction:

The man has been able to achieve his comforts in many areas of life through using technology and technological development. Not only did the architect to achieve the means of rest, but began using modern technology in the house has been converted from a residential building consumes energy to an environmentally friendly residential building capable of recycling energy and consumption of the least of them.

A case study in which energy consumption is calculated and control solutions to reduce cost (electricity bill).

An example of a residential unit ($170m^2$) consisting of 2 bedrooms, a living room, a reception, a bathroom, a kitchen, and a daily scenario for the number of hours used, the number and the electrical capacity, as shown in Table (1).

Name of device	Number of devices	Device capacity	Number of hours per day	consumption Power KW / day
LED lighting units	10	11	6	0.66
Air conditioning	2	1655	8	26.48
Refrigerator	1	500	24	12
Mixer	1	300	0.25	0.075
Boiler	1	400	0.50	0.2
Washing machine	1	1200	0.50	0.6
The heater	1	1400	0.50	0.7
Iron	1	1000	0.50	0.5
fan	1	20	6	0.68
Laptop	1	50	4	0.2
Vacuum cleaner	1	1600	0.25	0.4
Television	1	150	5	0.75
Total energy consumed per day				43.245
Total energy consumed in the month				1297.35

Table (1) shows the daily scenario of the number of electrical appliances used in the dwelling and the number of hours per unit.

<u>**Calculation of the value of savings in energy consumed first using Smart systems.**</u>

Using smart home systems, energy consumption is reduced to 40% (Ashour, 2006, p. 226)

Calculate the energy consumed per month after using smart systems: 1297.35 - 518.94 = 778.41 kWh

- Cost in pounds up to 350 kilowatts = (200 kg x 27[1] piasters) + (150 kg x 55 piasters) = 54 pounds + 82.5 pounds = 136.5 pounds

- Cost in pounds up to 650 kW = 136.5+ (300 * 75 piasters) = 136.5 + 225 = 361.5 pounds.

- Cost in pounds up to 778.41 kW = 361.5+ (128.41 * 125 piasters) = 522.013 pounds.

- What was saved in the cost = 1751.4 pounds - 522.013 pounds = 1229.39 pounds.

The amount expected to be provided in the year = 1229.39 * 12 = 14752.65 pounds.

The value of the proposed systems is 2007$ And through the provision of the provision during the year 14752.65 pounds, **Thus, this initial cost of the Smart system would be covered in two years and 4 months.**

<u>**Calculation of the value of savings in energy consumed Second: Using solar cells.**</u>

The average electricity production per square meter per day, month, and a year was calculated by the PVWatts Calculator as shown in Figure (2). Thus, the average electricity production per square meter per day = 67.339 / 12 = 5.6 kW / day (NREL)

The total cost of the solar system =28074.891 pounds.

1. The cost per pound for the annual bill = 1751.4 * 12 = 21016.8 pounds.

Thus, this initial cost of the solar system would be covered in one year and three months.

In the case of the integration of the smart system, which provides 40% of electricity, and the solar system, which produces 60% of electricity will reduce the cost of the solar system to become 25391 pounds instead of 28074.891 pounds.

Figure (2) Calculation of daily electricity production by PVWatts Calculator. The program is available at https://pvwatts.nrel.gov/pvwatts.php

The total cost of the two systems is 61035.32. The cost of the two systems will be Refund after two years and nine months, after which the profits will be realized for the house as it will become zero energy.

Conclusion:

In this paper, technology was used to control energy through two methods: The first is Energy saving through using the intelligent systems of sensor that reduce the consumption of wasted energy from the users, and the second acquisition of energy using solar cells, the production of electricity was calculated daily by the PVWatts Calculator. A strong relation between energy saving or production and saving in cost is obtained.

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[1] http://egyptera.org/ar/t3reefa.aspx

Results:

- Maintaining limited sources of energy and maximizing the use of renewable energy sources such as solar energy, whose technologies are expected to spread over the next two decades.
- Providing energy consumed in the home after the use of smart systems with an efficiency of up to 40% of the total energy consumed before use by saving wasted energy when users exit the vacuum.
- Intelligent systems determine the specific amount of energy consumed. This amount is divided between the adaptive system, lighting, and household appliances, but the bulk of the air conditioning system consumes about 61% of the total daily energy consumed in the dwelling.
- The possibility of recovering the value of smart systems after two years and four months and solar cells after a year and three months or in the case of the two systems were integrated with the house will be cost recovery after two years and nine months and after that profit is realized for the house and can sell electricity in case of non-consumption.
- It is not necessary to use all intelligent systems in the house, but as can be satisfied with the house with energy control systems for conditioning, lighting, and devices, it is necessary to study the need for these systems according to the nature of the building and its size, environment and services.

Recommendations:

- The necessary awareness should be given to the importance of energy-saving systems, their environmental benefits and the economic benefits of their use, although their cost is high but represents 6% of the cost of the unit by the previous example and then begins its financial return after the first years of using these systems of energy saving.
- Awareness should be placed on the framework of private companies, government institutions, and individuals because they are all owners or employees of the community to meet the standards of energy use and rationalization.
National orientation towards changing lifestyle and consumer behavior to rationalize the use of energy and to undergo new experiments to keep abreast of the times and break the barriers of
Fear of everything new.
- Introducing government projects that contain smart systems. Local companies are forced to take up the field and develop policies, incentives for investment and tax systems that encourage the establishment of such projects.
- Study of the wasted energy on the adaptation system in Egypt leads us to the importance of using energy saving systems and benefiting from them in other fields.

References:

Books:

1.   H, Morrison .*Digital Video / TV , A.E.C.T* .Houston: National Convention. (1999).
2.   C, Binggeli .*Building Systems For Interior Designers* .John Wiley & Sons, INC. (2003), p129.
3.   Fisher, Ernest .*The Necessity of Art .trans*: Anna Bostok, Penguin Books, (1969), p7.

4. John & Sons Wiley .*Introduction, Designing For a Digital World* .(2002).

5. Michelle and Schodek, Daniel Addington.*Smart Materials and New Technologies* . Harvard Universities, Architectural Press, An Imprint of Elsevier. (2005), p114-115.

Articles from Periodicals:

6. Amir Sanaee .Smart Home Technology and Architecture . Iran: Department of art and architecture,Shabestar branch, Islamic Azad university, Shabestar, (2014), p2.

7. Borzooeian, Mohammad, Passive Solar Design in Ecological Houses, Department of Architecture,Eastern Mediterranean University,Northern Cyprus, (2014), p1.

8. David Bregman .Smart Home Intelligence - The Home that Learns .International Journal of Smart Home, Vol.4, No.4. (2010) .

9. Ashour, Ibrahim Attia .Energy Saving Through Smart Home .Alexandria, Egypt: Electrical Department and Computer Engineering, Arab Academy for Sciences and Technologies. (2006).

10. Robles, Rosslin John .Applications, Systems, and Methods in Smart Home Technology: A Review .Korea: Hannam University, Daejeon, International Journal of Advanced Science and Technology Vol .15. (2010), p38.

11. WCSD, World Business Council for Sustainable Development .Energy Efficiency in Buildings .(2010), p2.

12. Harrison, Michael Wigginton and Jude, Intelligent Skins, Architectural Press , an Imprint of Elsevier. Linacre House, Jordan Hill, Oxford, UK. (2002). p8-12.

13. Sinopoli , J. Smart Building Systems For Architects, Owners, Builders and. Elsevier Press An Imprint of Elsevierc, Oxford , UK (2010). p129.

14. Guzowski,Marry.. Towards Zero-energy Architecture New Solar Design. British. (2010),p29.

Websites:

15. NREL .National Renewable Energy Laboratory .available on https://pvwatts.nrel.gov/pvwatts.php(.Jul,9,2018)

16. http://www.cpas-egypt.com/pdf/Mostafa_Monir/Researches/002%20-.pdf: (Nov,30 ,2018)

17. https://www.pinterest.com.(Jul,7,2018).

18. http://www.arkitekturbilleder.dk/images. (Jul,7,2018).

19. http://www.ecostructure.com .(Jul,7,2018).

20. http://egyptera.org جهاز تنظيم مرفق الكهرباء وحماية المستهلك .(Jul,9,2018).

21. http://www.electasolar.com , شركة اليكتا .(Jul,9,2018).

22. http://www.electasolar.com/product, (Jul,9,2018). at 7:30 pm.

23. https://nasrsolar.com, (Jul,9,2018) ,at 7:36 pm.